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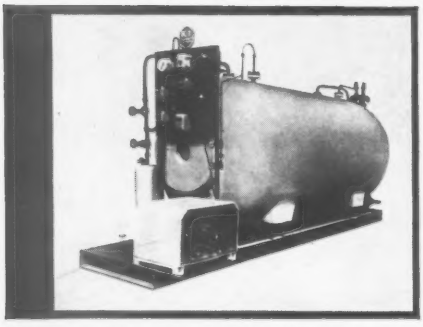

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British Cast Iron Research Association

We wonder if 40 years ago, those foresighted—but lazy—foundrymen who clamoured for a research association to cover the field of cast iron, envisaged such a growth as is evidenced by the Annual Report of the BCIRA published elsewhere in this issue. We have designated them lazy, because they did nothing other than talk or write. Even after the Association was started, there was, until Dr. Pearce was appointed as director, five years of more talk and but little else. Since that change was made, progress has been most marked and at a constantly increasing tempo until to-day it is recognized as the premier research organization in the world devoted purely to cast iron.

The programme of research is particularly well balanced as between long-term and current applications. An example of the former is creep testing to provide engineers with data which may be used with safety. For current work, extensive experiments are being made to develop CO_2 practice. Whilst the staff is alike numerous and well qualified, there are still many subjects requiring investigation, but they are costly and require the backing of the industry as is expressed through its Council. One which we should place high in the list is the reduction of noise in foundry practice. We are well aware that when the Association turned its attention to the amelioration of foundry atmospheres the cost was much greater than was originally forecast. A study of noise reduction will not be cheap.

Reading through the Report, one cannot be but impressed by the huge quantity of measurements that must be taken every year. The staff must indeed be extremely aware of the value of instruments. Indeed, periodically a course of lectures and demonstrations is given on sand testing, so that founders can appreciate the great value to be derived from the intelligent use of instruments in this vital activity of the industry. A cupola installation is in course of construction at the Association's headquarters near Birmingham, and this will be furnished with a multitude of instruments to register every item applied in the conduct of this form of melting practice. We look forward to the time when cupola control will be the subject of organized courses at headquarters similar to those now devoted to sand testing. Instrumentation in all branches of the foundry industry is in its infancy compared with the iron and steel industries, though there are, of course, some notable exceptions. Unfortunately, despite all the progress made in pyrometry, the time is still remote when, in general conversation between founders, the temperature of the metal at the spout will cease to be dull, hot or b . . . . y hot!

G

European Foundry Apprentice Competition

It is now possible to record further information about the three foundry apprentices who will represent this country in this year's European Foundry Apprentice Competition* to be held in Stuttgart, Germany, from Monday, November 25, to Saturday, November 30, inclusive. All the young men selected are students of the National Foundry Craft Training Centre. They are:—

Edward Carl Sykes, aged 18 years 9 months, who works for H. Downs & Sons (Huddersfield), Limited, Peacock Works, Leeds Road, Huddersfield. He has been making machine-tool, textile and gear castings and became an apprentice in 1954. Edward is as keen a footballer as he is a craftsman. As to his foundry prowess, he took the City and Guilds' Course at Huddersfield Technical College and obtained both intermediate and final certificates in three-years' part-time study, as compared with the normal period of five years.

Richard Edward Spencer, aged 19 years 8 months, works at the foundry of James Smethurst & Son, Limited, Foundry Street, Warrington, Lancs. He started there in September, 1953. He was highly commended, when he was only 15 years old, in an apprentice competition conducted by the Institute of British Foundrymen, and at 17 took a second prize in a similar competition. He is a footballer, plays goal for his local team, and is a youth club member at Warrington.

Philip Thomas Roberts, is the youngest of the three. He is 18½, and has shown such promise that he has frequently been put on experimental proving jobs by his company, the Bridge Foundry Company, Limited, Wednesbury, Staffs. Outside his work, he is a keen member of the Boy Scout movement and is now assistant scoutmaster of the Sixth Walsall Troop.

Organization

The competition is the first of an annual event organized by the European Committee of Foundry Associations, in which the United Kingdom foundry industry is represented at present through the Council of Ironfoundry Associations, and the British Steel Founders' Association (though it is expected that, shortly, the Association of Bronze and Brass Founders and the Light Metal Founders' Association may be admitted to membership). Each of the member countries, all in Western Europe, may enter three candidates. Britain's three young men were selected from a "short list" of nine compiled by the Institute of British Foundrymen, at a meeting in the National Foundry College, Wolverhampton, held on October 16. The fares and expenses of the UK competitors while at Stuttgart will be paid by the foundry industry of this country.

An important rule is that the competitors must be under 20 in the year of the competition and the British entrants are all actually serving an apprenticeship at this time. Special permission has been obtained for the UK competitors, who normally do not finish apprenticeships until 21, to compete against their Continental brethren, most of whom, at 19, will have completed their full apprenticeship. Tests the competitors will undergo during the Stuttgart week will cover practical foundrywork, technology, drawing, calculation, and general knowledge. The winners will receive prizes, and the country with the greatest number of points will win a trophy.

Through the medium of this publication, the JOURNAL staff join with British foundrymen from all over the world in encouraging and sending good wishes with these three competitors to Stuttgart. It is certain that in the various tests they will uphold this country's traditional excellence in foundry skills and acquit themselves well, whatever be the final result.

* Details of the rules and other arrangements governing this annual event were published in the JOURNAL, July 25, 1957, p. 109

Dinner

JOINT IRON COUNCIL

The annual dinner of the Joint Iron Council was held at the Dorchester Hotel on Tuesday last. About 660 were present and the president, Mr. N. P. Newman, was in the chair, the guest of honour being the Minister of Power, Lord Mills. Included in those listed among the guests were:—

Mr. Hubert Ashton, M.P., Sir George Barnett, Mr. G. Beharrell, Mr. J. Blakiston, Mr. David Blee, Mr. F. C. Braby, Dr. J. S. Carter, Mr. R. Gresham Cooke, M.P., Lieutenant-General J. G. Cowley, Mr. Kenneth N. Davis, Mr. John Dugdale, M.P., Sir Roger Duncalfe, Sir Lincoln Evans, Dr. A. B. Everest, Mr. C. F. Fletcher-Cooke, M.P., Sir Archibald Forbes, Mr. C. S. Garland, Sir Robert Hall, Sir Noel Hutton, Sir Roland Jennings, M.P., Mr. R. S. Johnson, Sir Henry Jones, Mr. M. C. de Jong, Mr. J. Latham, Mr. Malcolm MacPherson, M.P., Sir John Maud, Mr. G. M. Menzies, Sir John Morison, Mr. R. P. Morison, Q.C., Mr. Jack Owen, Dr. J. G. Pearce, Sir Stanley Rawson, Sir Peter Roberts, M.P., Sir Leslie Robinson, Mr. S. H. Russell, Sir Frederick Scopes, Sir William Scott, Mr. W. S. Shepherd, M.P., Sir Robert Shone, Mr. Sydney Smith, Mr. R. H. E. Thomas, Sir Edward Thompson, Mr. J. Stanleigh Turner, the Rev. R. B. R. Walker, Major-General Ll. Wansbrough-Jones, Sir Owen Wansbrough-Jones, Colonel J. W. Watkins, Lieutenant-General Lord Weeks, Sir Harold West, and Mr. Fitz-Herbert Wright.

After the loyal toasts, the "Iron Industry" was proposed by Lord Mills and replied to by the chairman; the toast to "The Guests" was proposed by Mr. M. J. Glenny (member of the executive committee of the Joint Iron Council, and deputy chairman, the Council of Ironfoundry Associations), and Col. Sir Harold Smith, chairman of the Gas Council, responded. This concluded the formal part of the proceedings.

European Free-trade Area

The Treasury has issued a 32-page book, illustrated with charts and maps, on the proposed European Free Trade Area ("Freer Trade in Europe," Stationery Office. 2s. 5d. net.) This book, which has a foreword by the Chancellor of the Exchequer, does four things. It explains the proposed European Economic Community of the six European countries, and sets out how the free trade area would fit in with it. It answers questions arising from the proposals. It gives many facts about Western Europe—size of market, growth, trade, and wages. And it contains a summary of the tariff and quota provisions of the European Economic Community Treaty (the Treaty of Rome), signed on March 25, 1957.

The book does not argue a case. It provides the information which will enable the reader to understand what is going on in the negotiations during the rest of this year; and it gives facts and figures about Europe to help him assess the scope and possible impact of the proposals on British industry.

Refractories and Mould Materials for Vacuum Melting and Casting*

By H. O. McIntire

Vacuum melting has been used for quite some time, mainly as a research tool, but only recently has the need for it for specific commercial applications become apparent. Vacuum melting of certain alloys for use in the wrought condition has moved ahead rapidly in the past two years, and if castings are to continue to be used in some applications, it is necessary that they, too, be melted and cast in vacuum. Alloys that benefit particularly by vacuum melting include the nickel-base alloys (which contain appreciable amounts of aluminium and titanium), high-aluminium iron-base alloys such as Thermenol, and certain grades of steels where the greatest possible freedom from non-metallic inclusions is needed, as in the (American) 52100 steel used extensively for bearings. While vacuum melting and casting poses some new problems to investment casters, it has already been demonstrated that the refractory problems are less difficult than one might expect. A considerable degree of success has been achieved with refractories commonly used for melting and casting in air at normal pressures.

Properties of Selected Refractories

Properties for some of the refractories that might be considered for lining melting furnaces, or for investment moulds, are listed in Table I. These properties are of importance whether melting and casting is done in vacuum or it is carried out in air at normal pressure. All the refractories listed, except silica and possibly mullite, are adequate—from the standpoint of melting temperature—for furnace linings for melting iron-, nickel-, or cobalt-base alloys. Magnesia has the highest melting temperature, 2,800 deg. C., with silica being the lowest at 1,713 deg. C.; mullite melts at 1,810 deg. C. and alumina melts at 2,050 deg. C. The thermal expansion of magnesia is 13.5 microinches per inch per deg. C., which is appreciably greater than for alumina and zirconia. The double-oxide zircon has the lowest thermal-expansion of the refractories listed. The exceedingly high thermal-expansion of silica results from phase inversions which are accompanied by large volume changes at certain temperatures. Because of these inversions, silica has very poor cracking and spalling resistance at temperatures below about 590 deg. C.

TABLE I.—*Properties of Selected Refractories.*

Material.	Melting point, C.	Thermal expansion, microinches per in. per deg. (27 to 1,000 deg. C.)	Thermal conductivity, B.T.U. per hr. per in. per sq. ft. per deg. C.	
			100 deg. C.	1,200 deg. C.
Magnesia (MgO) ..	2,800	13.5	250	44
Magnesia Spinel ($MgO \cdot Al_2O_3$)	2,135	8.5	104	38
Alumina (Al_2O_3) ..	2,050	8.5	209	38
Mullite .. ($3Al_2O_3 \cdot 2SiO_2$)	1,810	5.2	44	26
Silica (SiO_2) ..	1,713	16.0	—	—
Zircon ($ZrO_2 \cdot SiO_2$)	2,550	4.5	41	26
Stabilized Zirconia (ZrO_2)	2,700	6.7	14	17

The thermal-conductivity data are representative of high-purity materials corrected to zero porosity. Particularly at low temperatures, magnesia and alumina have high thermal-conductivities. Though the thermal conductivity of magnesia is a little higher than that of alumina, the latter has sufficiently low thermal-expansion to make it superior to magnesia in regard to thermal-cracking and spalling. Magnesia continues to be the most widely used refractory for lining melting furnaces, but alumina crucibles are reported to be giving excellent service in some foundries for making melts of the sizes normally

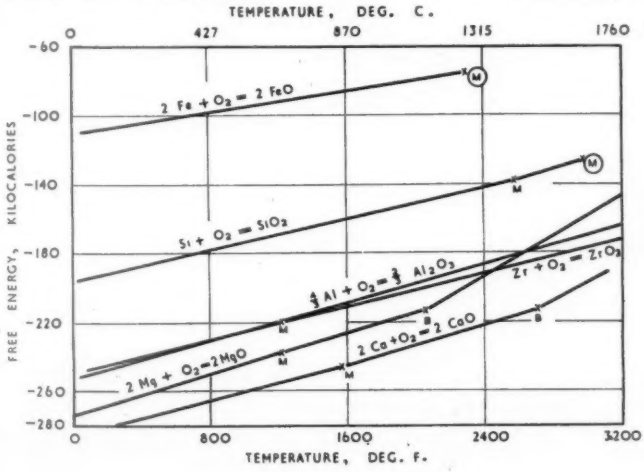

FIG. 1.—*Standard free-energy change in the formation of several oxides. (From data in US Bureau of Mines Bulletin* 542.)

Key: Melting points for metals, *m*, and oxides, *M*; boiling points, *B*.

* Paper presented at the Stratford on Avon conference of the European Investment Casters Association. The author is attached to the Battelle Memorial Institute at Columbus, Ohio. In his unavoidable absence, the Paper was read at the conference by Dr. W. Siegfried, a colleague from Battelle, Switzerland.

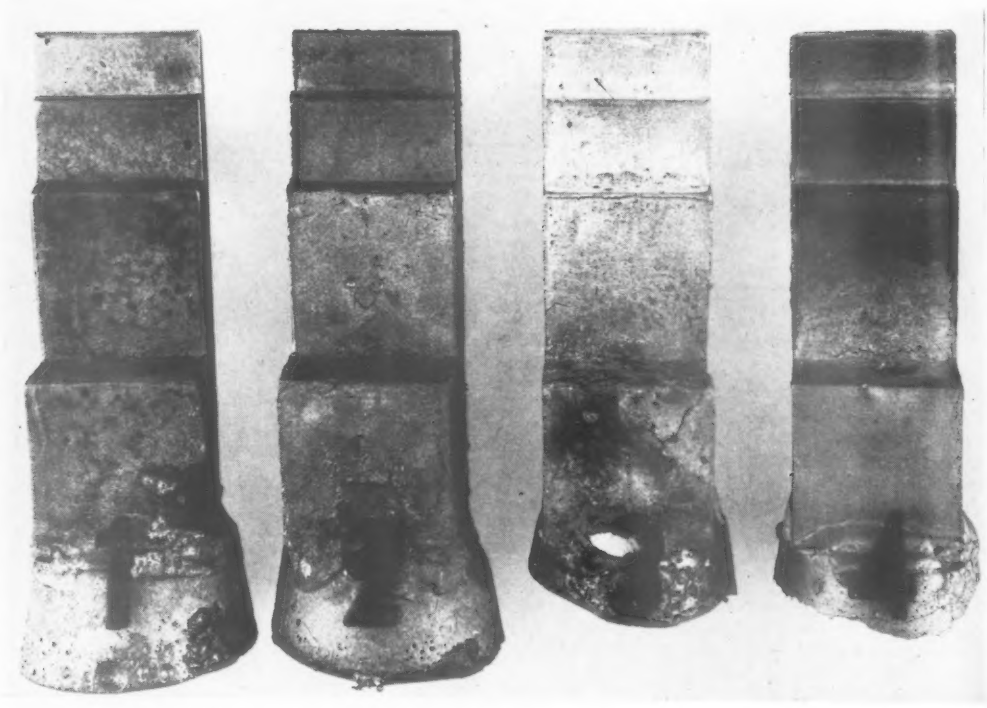

FIG. 2.—*Test castings made from X-40 alloy melted and cast in vacuum.*
The moulds were prepared from: No. 1—Commercial phosphate-bonded investment; No. 2—silica bonded with ethyl silicate, and Nos. 3 and 4—commercial high-temperature investment (essentially silica-flour), possibly with a phosphate binder.

used for investment-casting work. Zircon, and particularly zirconia, have very low thermal-conductivities; however, their thermal-expansions are low enough to give them good cracking and spalling resistance. Pure zirconia undergoes a structural change at about 1,090 deg. C. with a large change in volume; this change is avoided in stabilized zirconia by adding a fraction of a per cent. of calcium or magnesium oxide.

Thermal Stability of Selected Refractories

When the pressure is reduced to the range of 1 to 20 microns, as is done in vacuum melting, the factors of volatilization of materials and their reaction with, other materials they may be in contact with become of great importance. Certain reactions, such as between oxides and carbon or hydrogen, are often facilitated by reduced pressures. A measure of the stability of materials at high temperatures and low pressures can be obtained from the free energy of formation. For example, in the formation of alumina from the metal and oxygen, a large quantity of heat is liberated just as heat is liberated when coal is burned in a furnace. The greater the amount of heat liberated at any specific temperature in forming a compound, the greater the stability of the compound will be. Fig. 1 is a graph of the free energy of formation, as a function of temperature for the reaction of several metals with oxygen to form the corresponding oxides. Thermal stability, which implies resistance to dissociation or reduction at elevated temperatures, increases as the free-energy change become more negative. Therefore, calcium-oxide should be the most stable of those plotted in Fig. 1. Thorium-oxide is even more stable, but it is of no interest for commercial investment-casting work, because of its high cost. Calcium-oxide has not been used much for refractory purposes because it forms low-melting-point compounds with certain other oxides and, in addition, readily forms hydrates and carbonates under normal atmospheric conditions.

At temperatures up to about 1,370 deg. C., magnesia is the next most stable oxide. Magnesium metal boils at about 1,150 deg. C., and above this temperature, the free energy of formation for the oxide decreases rapidly. At temperatures above about 1,540 deg. C., the free energies of zirconia and alumina indicate that they should be more stable than magnesia. Zirconia would be expected to be somewhat superior to alumina at the higher temperatures. One would expect silica, and particularly iron-oxide, to be reduced readily at low

pressures and high temperatures. Tombs and Welch[4] found the partial pressure of gaseous silicon-monoxide over silica to be 2.1 mm. at 1,300 deg. C. From this, it might be expected that reaction would occur between silica moulds and elements such as carbon, aluminium or titanium, when alloys containing these elements are cast into silica moulds in vacuum.

Refractories in Contact with Molten Metals

In contact with molten metals, all of the oxides mentioned dissociate to some extent, with the dissociation products being dissolved in the melt or given off as a gas. With alumina crucibles, for example, a small amount of aluminum and oxygen will dissolve until equilibrium is established between the crucible and the metal. When attempting to make exceedingly pure metals, the crucible itself, therefore, may act as a virtually unlimited supply of oxygen. For commercial melting, however, this need be of no great concern. Hadley and Bianchi[5] studied the deoxidation of pure iron, nickel, and cobalt in vacuum. Some of the melts were prepared in magnesia crucibles and deoxidized with hydrogen. Their results indicated equilibrium between the melt and the magnesia crucible at about 0.005 per cent. oxygen for iron, 0.003 per cent. oxygen for nickel, and 0.001 per cent. oxygen for cobalt. With iron melts made in alumina and zirconia crucibles, the equilibrium oxygen contents were 0.005 and 0.007 per cent., respectively. Oxygen contents reported by Spendelow of Haynes-Stellite Company[6] for a large number of nickel-base alloy melts, made in vacuum in magnesia crucibles, averaged a little less than 0.003 per cent. Thus, there appears to be little practical difference in the oxygen levels that can be attained in magnesia, alumina, and zirconia crucibles under normal vacuum-melting conditions. Also, it is evident that the level of oxygen contamination from high-purity crucibles is not excessive for commercial applications.

Investment Moulds for Vacuum Casting

The requirements for a mould material to receive molten metal, in some respects, are less stringent than those for melting crucibles. This is true because the metal solidifies quickly after it enters the mould, and the time available for reaction between the melt and the mould surface is quite short. However, any reaction at all that results in formation of a gas-

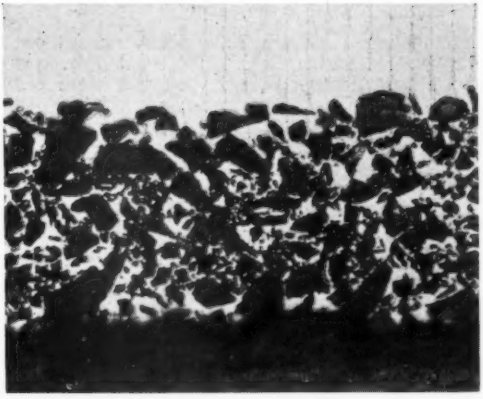

FIG. 3.—*Photomicrograph showing metal penetration into the surface of an investment mould.—X-40 alloy cast in vacuum;* ×250 *magnifications.*

eous product is much more troublesome when casting in vacuum than when casting at normal pressure. This results from the fact that a given weight of gas at 10 microns pressure, for example, occupies about 76,000 times as much space as it does at atmospheric pressure. If the gas cannot pass through the mould readily, it is likely to cause gas pockets in the surface of the casting or may blow back through the metal.

In addition to the increased possibility of gas formation from reactions between the metal and the mould when casting in vacuum, most refractories fired at 1,010 deg. C., for example, contain components that are volatilized on further heating caused by contact with molten metal at higher temperatures. On several occasions, moulds made from a commercial phosphate-bonded investment have

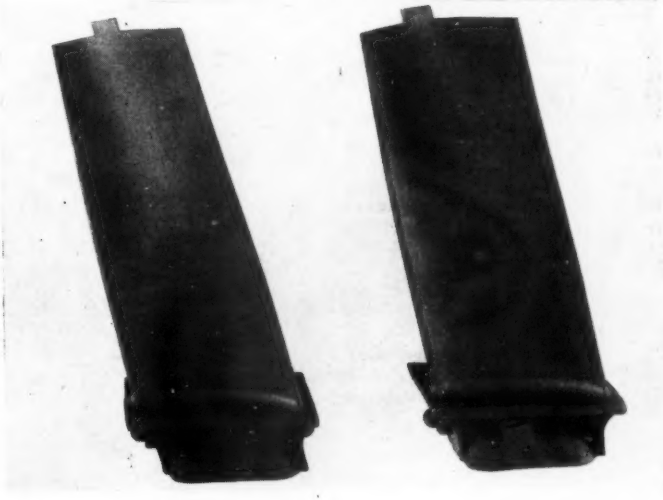

FIG. 4.—*Nickel-base-alloy turbine blades vacuum melted and cast in a silica mould (bonded with ethyl-silicate) having a sodium-silicate-bonded precoating.*

Vacuum Melting and Casting

been vacuum cast at the Battelle Institute. Although the moulds were heated to 1,010 deg. C. before casting, violent gassing occurred when the molten metal entered the mould. Moulds bonded with ethyl-silicate, on the other hand, have been reasonably satisfactory, with only a small amount of gassing being apparent. In an effort to determine the reason for the difference in behaviour, specimens ½-in. dia. were prepared from the commercial investment material and similar specimens were made from silica bonded with ethyl-silicate and silica bonded with sodium silicate. The specimens were fired for 1 hour at 1,010 deg. C. in air, cooled to room temperature, and weighed. They were then placed in a resistance-heated furnace and heated to 1,455 deg. C. for 30 min. at 0.1 to 0.5 micron pressure. After cooling again to room temperature, the specimens were reweighed. It was found that the phosphate-bonded investment had lost about one per cent. of its original weight while the sodium-silicate- and ethyl-silicate-bonded investments lost about 0.1 per cent. of their original weights. Since this weight was lost by volatilization, it is evident that entrance of molten metal into such a phosphate-bonded mould in a vacuum would result in a large volume of gas being evolved.

Test Castings

Fig. 2 is a photograph of four test castings being made from X-40 alloy* cast at pressures of about 10 microns. The castings are shown just as they appeared after knocking off the investment mould material. These castings were 1-in. wide and the section steps were 1-, ½-, ¼-, ⅛-in. thick. Casting number (1) was made in a mould prepared from the commercial phosphate-bonded investment already mentioned, and having an ethyl-silicate-bonded silica precoating. The mould was cast at 1,010 deg. C. and, as for the other castings, the metal temperature was about 1,565 deg. C. The metal bubbled vigorously after it entered this mould; the well-rounded holes near the top of the casting are evidence that gas pockets were present at the time of solidification. Casting number (2) was made in a silica mould bonded throughout with ethyl-silicate. There was a little evolution of gas from the top of the metal after this casting was poured, but it was much less than for mould number (1). The third and fourth castings were made in a second commercial high-temperature investment, essentially silica-flour, and possibly (4) also having a phosphate binder. The third casting was poured with the mould at 1,010 deg. C., but for the fourth casting, the mould was heated 1 hour at 1,010 deg. C. in vacuum, then cooled to 705 deg. C. for casting. Gassing was quite severe for the mould cast at 1,010 deg. but was much less with the colder mould.

The investment separated easily from the metal surfaces of all the castings (leaving them bright and clean) except for the thinner sections of the fourth casting. It is rather surprising that what appears to be metal penetration, or "burn-in," occurred with this mould rather than those cast at the higher temperature. It is suggested that, with the hotter moulds, sufficient fusion of the mould surface occurred to close it and prevent metal penetration. "Burn-in" of the type observed on this fourth casting was experienced previously in vacuum casting into this same kind of investment and a section through the surface of one of the castings is shown in Fig. 3. The darker areas are silica particles with the metal appearing as white intergranular material. The appearance of this layer suggests that there was reaction between the mould surface and the melt. This condition was not experienced when Argon was introduced into the mould before casting.

Although mould gassing and metal penetration may be increased when casting in vacuum (as compared with casting at atmospheric pressure), some very good castings have been made in vacuum. Fig. 4 shows a pair of nickel-base-alloy turbine-blades that were cast in a mould bonded with ethyl-silicate and having a sodium-silicate-bonded precoating. The surfaces were very good except for a few small pits which probably were caused by loose refractory.

Thus, it appears at the present time, that silica investment moulds are adequate for the vacuum casting of most metals. However, if it should be found that excessive mould reaction and gassing occur when casting certain alloys, the more stable refractories, alumina, zircon, or zirconia, may provide a solution. Also, greater permeability in the mould would be a definite advantage, as the gases could then escape without being forced into the metal. This makes the shell-moulding technique appear particularly advantageous. Both the "Mercast" process wherein a shell is formed on a frozen-mercury pattern, and the "Glascast" technique which uses wax patterns, appear to be applicable.

Summary

Magnesia or alumina refractories currently used for lining melting furnaces appear to be entirely adequate for vacuum melting the iron-, nickel-, and cobalt-base alloys that are of interest to the investment-casting industry. If the operating temperatures exceed about 1,590 deg. C., zirconia may offer some advantages over magnesia and alumina because of its greater thermal stability. Although good castings have been obtained by vacuum casting in conventional investment-moulds made with silica, there is reason to believe that most alloys of interest to founders may react to some extent with silica. If this is proved to be the case, some advantage may result from use of precoatings made with alumina, zircon, or zirconia. Shell moulds should permit easier escape of gases than is obtained with the conventional type of investment moulds.

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* X-40 is a chromium/nickel/cobalt/tungsten alloy mainly used for gas-turbine blades.—Editor.

DISCUSSION

THE CHAIRMAN (Mr. W. H. Sulzer), opening the meeting for discussion, said Mr. Siegfried would probably not be able to answer all the questions, but they would be recorded and sent to Mr. McIntire for written replies.* Vacuum metallurgy was quite topical nowadays, and when formulating the conference programme it had been felt that it would be interesting to have papers on this subject, because many of those attending the conference would have to deal with it in due course.

MR. H. J. MEERKAMP VAN EMBDEN (N. V. Philips, Holland) said the paper referred to stabilized zirconia, and asked how it was made. He knew only the unstabilized zirconia, which has allotropic changes and gives irregular expansion on heating. How was the stabilizing oxide put in? As zirconia has a high melting point and is very inactive, surely stabilization of this product has to be caused by a chemical change?

MR. SIEGFRIED said that stabilized zirconia could be bought in the open market.

THE AUTHOR adds that stabilized zirconia is made by adding 4½ to 6 per cent. of calcium oxide and heating the mixture at 1,370 deg. C. in a rotary kiln. This treatment converts the unstable monoclinic structure to the stable cubic structure. The stabilized material is a commercial product and can be obtained from suppliers of special refractories.

Metal/Mould Reactions

MR. LISTER (Fairey Aviation Company, Limited) said it was stated in the last paragraph of the paper that there was reason to believe that most alloys of interest to investment founders may react to some extent with silica, and if that were proved to be the case, some advantage might result from the use of pre-coatings made with alumina, zircon or zirconia. He asked how many bondings that would take.

THE AUTHOR replies that alumina, zircon or zirconia were suggested because of their greater thermal stability in comparison with that of silica. One of these materials would be substituted for the silica normally used for the primary or precoat, but otherwise the procedure would be unchanged.

MR. V. DI SAMBUY (*Associazione Italiana di Metallurgia*, Milan) said that, while he heard occasionally about vacuum melting and its advantages (*i.e.* processing and refining of metal in vacuum furnace followed by pouring and casting in air) he heard very little about vacuum casting (*i.e.* pouring directly into a mould which was also in the vacuum furnace). What would be the advantages of the latter procedure?

MR. SIEGFRIED replied that if the metals were prepared in a vacuum, the hydrogen was eliminated, and if they were poured in air afterwards there was seldom time for hydrogen pick-up; but if the metals were likely to pick up hydrogen, it was better to pour them also under vacuum. Furthermore, if, for example, the melt had a high content of titanium or any metal having a high affinity for oxygen, then during pouring in air there could be oxidation, so that for such metals it was necessary to pour under vacuum.

THE AUTHOR reports that whether or not it is beneficial to pour the melt in a vacuum depends upon the characteristics of the metal being cast. The additional degassing achieved is sometimes worthwhile. If the alloys contain reactive elements such as aluminium and titanium, loss of these elements by oxidation is prevented and in addition improved "castability" is achieved.

Optimum Permeability

MR. E. J. CRAWLEY (Chambers Bros., Limited, Sheffield) said the Author had drawn attention to the importance of the permeability of the investment for castings melted in vacuum and poured in vacuum, and also to the effect of metal penetration. In comparing casting in vacuum with normal methods of casting, not under vacuum, he asked if it were expected that vacuum casting would need a more permeable investment material than would be used normally. In other words, one had to compromise between metal penetration and permeability; was it best to secure greater or less permeability?

THE AUTHOR replies to the effect that if the metal and mould are thoroughly degassed, prior to pouring, and there is no gas-producing reaction between the metal and the mould surface, it seems likely that less mould permeability would be required for vacuum casting than for casting in air. On the other hand, if one of the various gas-producing situations exists, a given weight of gas would be more serious when casting in vacuum and increased mould permeability would then be helpful.

MR. LISTER asked what bond was used in the refractory for the melting crucible.

MR. SIEGFRIED replied that in Geneva the crucibles were made of zirconia and there was no need to use a bond. The crucibles were treated in the induction furnace.

THE AUTHOR adds the information that the crucibles used in making the melts mentioned in his paper were obtained from a commercial source. The type of bond used in making them is not known to the author, but it seems likely that it was a high-alumina clay.

Economics

MR. D. R. WOOD (Mond Nickel Company, Limited, Birmingham) raised the question of the economics of vacuum melting and casting as compared with air casting. If vacuum melting and casting were adopted because the yield was low when using conventional methods, he asked, how much higher yield would be needed to justify the much greater expense of vacuum casting? Compared with conventional methods, the amount of control required would be greater and more expensive. There were, presumably, other reasons in addition for wanting to use vacuum casting.

MR. SIEGFRIED said a general answer could not be given to that question. It all depended on the

*In this report, the Author's remarks amplifying Mr. Siegfried's replies have been incorporated as and when appropriate, although, of course, they were obtained subsequent to the actual meeting.

qualities of the alloys which were being cast and on the properties they derived from vacuum pouring. If there were no big improvement arising from vacuum pouring the particular alloy used, the high cost entailed was not justified. Each individual case must be considered on its merits.

MR. D. H. ARMITAGE (P. I. Castings (Altrincham), Limited), suggested that, in theory, a simple way of overcoming the lack of permeability of the mould—although he did not know about the practical application of it—would be to employ centrifugal casting. He asked if the author had considered that.

THE AUTHOR'S opinion is that centrifugal casting is a practical method for overcoming the effects of gases when casting into moulds having low permeability. However, it further complicates the vacuum-casting process, and has some inherent disadvantages for casting certain shapes.

Pouring Details

DR. J. F. WATKINSON (B.S.A. Research Group) asked for how long the moulds were degassed in vacuum prior to pouring the metal into them. It was said that the metal was poured into moulds which were heated to 1,010 deg. C. before casting; he asked for some details of the arrangements for transferring the moulds to the vacuum chamber at that temperature. As to casting under argon, had the Author experienced trouble with gas bubbles on the surfaces of the castings?

Finally, he asked if the Author could give some general details of the induction-melting and vacuum-casting units used, which would help in assessing the information already presented.

THE AUTHOR replies that the moulds were prefired at 1,010 deg. C. in an electric-muffle furnace, then transferred directly to a resistance-heated holding furnace in the vacuum chamber. The chamber was then "pumped down" and the melt was prepared. The total time the hot moulds were held under vacuum was one hour. Melting was done in a tungsten-element resistance furnace in preference to induction heating. No difficulty was experienced with gas bubbles on the surfaces of the castings when casting was done in argon.

MR. L. N. HOCKING (Trucast, Limited) asked if Mr. Siegfried had found any dissociation with the sintered zirconium crucibles which he had tried in Geneva and if so to what extent did he find this dissociation with alloys containing titanium and alloys not containing this element. He also asked what type of deoxidation method, if any, it was necessary to use.

MR. SIEGFRIED replied that he made high-cobalt alloys, also alloys with titanium (though with not more than 1 per cent. of this element) but he could not find zirconium in the alloys after melting. For deoxidation he used calcium silicide.

Practical Experience

MR. J. AHERNE-HERON (Trucast, Limited) said his company started vacuum casting in the 'forties, as they had considered it would be a help to run the metal into moulds in vacuum because there would not be any gas or atmosphere to displace. Subsequently, after a considerable amount of work had been carried out, vacuum pouring, into both permanent and investment moulds, they were now of the opinion that founders were unlikely to cast in vacuum because of the problems of feeding castings under low gas-pressures. There were also other difficulties and he considered founders were much more likely to favour controlled-atmosphere casting. However, there was still the problem of the ability of molten metals to flow freely, as well as the necessity to develop foolproof equipment suitable for use in a foundry. He asked whether the Author had ever used dry argon instead of vacuum for casting and if so, had he any comments. With regard to the refractories and the problem of the affinity of the metals for oxides, etc., the difficulties referred to earlier did not appear to be great. With the pressures and conditions his firm used in their development work, it had been found possible to use normal refractory materials.

THE AUTHOR reports that, when casting cobalt-base alloys containing 0.5 per cent. carbon into silica investment moulds, he found there was sufficient metal/mould reaction to produce an excessive amount of gas. Also, there was an undesirable amount of metal penetration into the mould surfaces. Both of these conditions were eliminated by introducing argon into the vacuum chamber just prior to making the cast.

MR. N. WALKER (Hadfields, Limited), commenting on the remarks of Mr. Wood (who had asked what was the justification for vacuum melting) suggested that the only answer was that founders were becoming increasingly conscious of the necessity to improve the quality of their castings. At this stage they had the idea—though he did not think, necessarily, there was conclusive proof—that by adopting vacuum casting they could offer castings which would withstand more arduous conditions of service.

DR. WATKINSON asked if Mr. Siegfried considered that the gassing trouble in vacuum casting was uniform with different types of alloy. Had the same results been obtained in nickel-base alloys containing low carbon content as with those described for cobalt alloys with carbon contents from 0.3 to 0.5 per cent.?

MR. SIEGFRIED said that in the nickel-base alloys he had dealt with, the carbon content was not very low, it was between 0.1 and 0.3 per cent., so that he could not say what could happen if the carbon content were very low.

THE AUTHOR adds the opinion that most of the gassing observed must have resulted from carbon in the melt reacting with silica of the mould surface and forming carbon monoxide. Reducing the mould temperature prior to casting greatly reduced the tendency for gas formation. Also nickel-base alloys containing from 0.05 to 0.10 per cent. carbon could be cast without difficulty.

THE CHAIRMAN, in closing the session, asked Mr. Siegfried to inform Mr. McIntire that the members had much appreciated the paper and expressed the thanks of the assembly to Mr. Siegfried for presenting it on behalf of his American colleague.

British Cast Iron Research Association

Annual Report for the Year Ending June 30, 1957

At the annual meeting of the British Cast Iron Research Association held in the Connaught Rooms, London, last Tuesday, the following report, covering the year's activities to June 30, was presented:—

At the annual general meeting held in London on November 6, 1956, Mr. J. J. Sheehan, B.SC., A.R.C.SC.I., was elected president, and the following were elected vice-presidents: Sir Vincent de Ferranti, M.C., Mr. Francis D. Ley, J.P., T.D., Major R. Miles, B.SC., M.I.MECH.E., Sir Percy Mills, BT., K.B.E. (now Lord Mills of Studley), Mr. W. T. Wren, and Mr. H. J. V. Williams.

During the year the Council, under the chairmanship of Mr. S. H. Russell, held six meetings, and nine meetings were held by the advisory committee. The main committees of the Council held 17 meetings. Mr. A. E. Peace continued as chairman of the research board and the research committee, Mr. R. L. Handley as chairman of the information committee, the late Mr. C. Gresty as chairman of the Foundry Atmospheres committee, and Mr. A. E. Pearce as chairman of the operational research team committee. Mr. H. J. V. Williams succeeded Mr. J. J. Sheehan as chairman of the development committee in January, 1957. Mr. R. Taylor has continued as chairman of the Scottish committee.

It is with deep regret that the Council has learned of the death of Mr. C. Gresty, since the end of the year reviewed in this report. Mr. Gresty served as a member of Council from 1948 onwards and was especially interested in the problems of dust control and in the improvement of the working atmosphere of the foundry. This interest was reflected in the services he so freely rendered as chairman of the Association's Foundry Atmospheres committee from its inception in 1950 until his death, which deprives the Association of a valued friend.

Mr. H. Field retired from the Council at the close of the year. The Council wishes to record its warm appreciation of Mr. Field's services both to the research board and the Council over a period of 30 years.

Twenty meetings were held by the sub-committees and panels of the main committees of Council, making a total of 52 meetings in all during the year.

The income and expenditure account for the year ended June 30, 1957, and the balance sheet as at June 30, 1957, accompanied the Report. Income at £197,871 is £499 greater than for the preceding year, although the Conditional Aid grant terminated at December 31, 1956. Grant-earning income has again exceeded £120,000, thereby enabling the Association to earn the maximum Government grant of £56,000. The Association is indebted to the Joint Iron Council which, by subscribing £113,934, again ensured that the grant-earning target was reached.

Revenue expenditure has risen from the previous year's figure of £138,194 to £160,312. Staff additions, and increases in the cost of materials and services have all contributed to the increased expenditure. The excess of income over expenditure for the year is £37,559, and of this amount £25,000 has been transferred to the buildings and equipment fund, and the balance of £12,559 added to the general fund.

The balance sheet shows that the net value of fixed assets is now £145,884, and current assets at £181,657 give an excess over current liabilities of £170,550. The buildings and equipment fund now stands at £225,000 and the general fund at £91,434.

Capital expenditure during the year amounted to £39,070. Commitments in respect of outstanding orders for capital items at June 30, 1957, amounted to £13,819, but it is anticipated that expenditure amounting to approximately £100,000 will be incurred by the end of the present quinquennium (June 30, 1959) on the provision of a cupola and ancillary equipment, the carrying out of alterations to the existing cupola building and providing a foundry atmospheres block. It is also hoped to commence work on the first stage of the new laboratory block.

"Open Days"

The first "open days" since 1954 were held on July 3 and 4. Well over 500 visitors attended, including representatives of member-firms, Government departments, research organizations, education bodies, trade associations and other bodies, and a number of visitors from the continent. The President, Mr. J. J. Sheehan, B.SC., A.R.C.SC.I., opened the new experimental melting shop on July 3. The new shop covers an area of 5,000 sq. ft., and the melting resources include an electric high-frequency unit consisting of four furnaces of 10-, 5-, 2- and 1-cwt. capacity, and a number of oil-fired crucible furnaces. A cupola will be installed later and will be equipped for cold- and hot-blast melting. The shop is equipped with sand preparation and moulding equipment, and a 5-ton electric travelling crane. The "open days" were fully reported in the Press and also by the BBC.

The visitors appointed by the Department of Scientific and Industrial Research, Mr. E. W. Colbeck, M.A., F.I.M., technical director of Hadfields, Limited, Sheffield, and Professor A. J. Murphy, principal of the College of Aeronautics, Cranfield, visited the Association on November 21, 1956 and Mr. E. W. Colbeck paid a further visit on May 14, 1957.

The services of the director, Dr. J. G. Pearce, to research and industry, were recognized by the award of the C.B.E. in the Queen's Birthday Honours List. During the year the director was

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elected to the engineering divisional council of the British Standards Institution.

The Council has announced the appointment of Mr. H. Morrogh as deputy director and Dr. H. T. Angus as assistant director to Dr. Pearce. These two appointments take effect from July 1, 1957, and both Mr. Morrogh and Dr. Angus continue in their functions as research manager and development manager respectively.

The director, Dr. J. G. Pearce, and Dr. H. T. Angus attended a public enquiry held in connection with the Clean Air Act, 1956 as witnesses on behalf of the industry. The case for the ironfounding industry was argued, on May 28, by Mr. K. Marshall, M.A., director of the Joint Iron Council, and the following, of whom the first three are members of Council, dealt with specific aspects concerning the industry: Mr. A. E. Peace (chairman of the research board and research committee), Mr. H. G. Hall (chairman of the malleable castings sub-committee), Mr. M. M. Hallett (member of research board), Mr. W. Brindley (Foundry Atmospheres committee), Mr. D. Phimister (chairman, technical committee of the Roll Makers' Association).

The director has given a further five addresses to trade associations on the work of the Association, concluding a series of such talks, begun in 1956, and comprising 11 in all.

Research Department

Phosphorus in Foundry Iron

A detailed examination has been made of the possibilities of the removal of phosphorus from molten pig-iron. A considerable number of small-scale experiments has been carried out on the top-blowing process to study slag-formation and the effect of slag-composition and gas-velocity on the loss of carbon and phosphorus from the molten pig-iron. Large-scale trials are in hand in co-operation with the inventors of the Kaldo top-blowing process.

Many small-scale siliconization and recarburization trials have been carried out in a small rotary furnace and a large-scale siliconization trial has been carried out using lime, alumina, and silica slags.

Mechanical Properties of Cast Iron

Long-term growth tests to evaluate the suitability of different types of cast iron for steam engineering applications are continuing. A battery of creep machines has been purchased to investigate creep-resisting properties.

Arsenic has been shown to have a beneficial effect on the formation of spherulitic graphite in nodular cast irons, and arsenic and phosphorus have been shown to confer substantial improvements on the high-temperature properties of the material. The influence of tin and arsenic on the properties of pearlitic nodular cast iron, and the behaviour of nodular irons in contact with various liquids, have been studied.

A considerable programme of work has been started to relate the mechanical properties of cast-iron to the eutectic cell size, that is, to the degree of nucleation of the melt. An examination is proceeding of the stress/strain curve for grey cast iron and its interpretation in relation to the structure and fundamental properties of the material. A short programme of work has been completed on the influence of residual elements on the high-temperature impact properties of ordinary grey cast irons.

Soundness of Iron Castings

An extensive investigation has been undertaken covering all aspects of the soundness of iron castings. Considerable progress has been made in studying the influence of melting, composition, and moulding variables on the phenomenon of sinking under bosses in light castings; useful data have also been obtained on the influence of design variables. A comprehensive statistical analysis of the incidence of drawing in light castings has been completed. The influence of carbon and manganese contents on soundness has been studied. An attempt is being made to relate the degree of nucleation of the melt to the solidification sequence and to the resultant soundness of iron castings. By various techniques factors influencing the solidification sequences of grey cast irons are being studied. The soundness of ingot moulds has been investigated in the foundries of several members, with particular reference to the rigidity of the mould.

Graphite Formation

Work has been carried out on the determination of the degree of nucleation of the melt by eutectic cell counting. Satisfactory techniques have been developed and applied to the process of inoculation and in ascertaining the effects of superheating, and titanium and hydrogen. The efficacy of various inoculants has been studied and a preliminary attempt has been made to correlate eutectic cell counts with mechanical properties. The construction of a furnace is in hand, to enable quenching and cooling curve experiments to be carried out, which will enable a precise assessment to be made of the degree of solidification at the time of quenching. Work has also been carried out to demonstrate the continuity of graphite flakes within each eutectic cell.

Gases in Cast Iron

Work on hydrogen pick-up from the mould and its relation to pinholing tendency continues, with special reference to the occurrence of pinholing defects in industrial practice. The effect of aluminium in promoting hydrogen pick-up and pinholing tendency has been further confirmed. The influence of aluminium in ferro-silicon has been studied and the inoculating power of ferro-silicon is shown to be related directly to its aluminium content.

The effect of hydrogen during the malleablizing of white cast iron has been studied using a dilatometric technique, and the significance of hydrogen dissolved in the melt before annealing and hydrogen in the annealing atmosphere has received special attention. The effect of hydrogen in relation to the acceleration of graphitization by preheating

treatment below the critical range has also been studied.

Further work has been carried out on the influence of oxygen on fluidity but this has so far failed to confirm the often reported effect of oxygen in reducing fluidity. The possibility of introducing hydrogen electrolytically into white cast iron has been studied. In connection with the origin of blister gases during the vitreous-enamelling process, the effect of moulding material and shot-blasting time on carbon monoxide evolution has been investigated.

Corrosion

Work on the pitting of ship propellers continues, with the support of the British Shipbuilding Research Association. Magnesium anodes have been installed in several ships using cast-iron propellers and the success of these is under constant surveillance by the Association. Special attention has been paid to the construction of the tail-shaft to predict electrical contact between the shaft and the hull. The influence of paint coatings in inhibiting pitting is being studied.

In the work on the corrosion of diesel engine waterways by anti-freeze solutions special attention has been paid to the depletion of inhibitors and the development of acid by those anti-freezes in use. A special rig has been developed to enable this work to proceed at the Association's laboratories.

White and Chilled Cast Irons

Cooling curves have been studied to investigate the influence of superheating on the structure and degree of undercooling during freezing of white cast irons. A special furnace has been constructed to enable relatively high cooling-rates to be achieved during these cooling curve determinations. Methods have been explored to determine the shape of the eutectic grains in white cast iron. Work is in progress relating the mechanical properties of white cast irons to the various types of structure that can be produced by differing degrees of superheat during melting.

With regard to the chilling tendency of cast iron, a comprehensive explanation has been developed for the characteristic distribution of the mottled zone in chilled test-pieces and this has been substantiated by various thermal-analysis experiments. The chilling tendency and mottle distribution are being related to the degree of nucleation of the melt, measured by eutectic cell counts. The influence of chill test-piece size and chiller size is being investigated.

The influence of trace elements on the chilling tendency of cast irons used in the light castings industry has been carefully examined. A study of the influence of composition and melting variables on the hot tearing tendency of small laboratory test pieces, and a statistical examination of data obtained from industrial plants have contributed to the elucidation of hot tearing in white-iron castings.

Malleable Cast Iron

A lengthy investigation of the influence of graphitization on the rate of decarburization in carbon-monoxide and carbon-dioxide atmospheres has terminated. This work, which relied on continuously recording thermal balances constructed by the Association, shows that graphitization has a great influence in irons containing unbalanced sulphur contents and reveals, contrary to previous expectations, that the rate of diffusion is not always the controlling factor in the rate of decarburization; the rate of solution of graphite appears to have a considerable influence as well. In certain circumstances, sulphur appears to delay the solution of graphite. This work will probably throw considerable light on the mechanism of carbide-stabilization by sulphur.

The principal factors influencing the occurrence of inverse greyness in malleable iron have been investigated and a tentative explanation of the mechanism of its formation has been put forward. In co-operation with certain member-firms, various methods have been investigated for the production of sound malleable-iron test-bars.

Ingot Moulds and Bottom Plates

The Association continues to co-operate with the appropriate sub-committee of the British Iron and Steel Research Association in investigating the production and life of ingot moulds and bottom plates. Special attention has been paid to the influence of trace elements in bottom plates and ingot moulds, and factors influencing the soundness of ingot moulds; a survey has been made of the production methods used by most British ingot mould makers; sulphur-segregation in ingot moulds has been studied, and an investigation of factors influencing the lives of bottom plates has been completed. The routine examination of large numbers of ingot moulds and bottom plates continues, at the request of individual ingot mould producers.

Fuels and Furnaces

An experimental hot-blast cupola unit with detachable well and melting-zone sections has been specified and ordered. The blast heater should provide hot blast up to 870 deg. C., and provision is made for water cooling the shell. Co-operative work has been carried out with a number of foundries on hot-blast cupola installations.

Moulding and Core Sands

Following the development of a successful apparatus by the Association's staff for the dielectric heating of sand specimens for mechanical testing at high temperatures, work has been carried out on the design and construction of an oscillator of higher power and frequency in the hope that even higher heating rates can be achieved, which will more nearly simulate those obtained in practice at the surface of the mould. Using the existing dielectric high-temperature apparatus, attention has been paid to the variation in properties produced in moulding sands by coal-dusts which have

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the same mechanical analysis, volatile matter and loss on ignition. The variation in high-temperature properties has been established.

Considerable work has been carried out on the carbon-dioxide sodium-silicate process. Modified methods of testing have been developed and the influence of various air/CO_2 mixtures on the gassing of sodium-silicate sands have been studied. Further work has included an examination of the behaviour of dried powdered silicate and the influence of standing time after gassing of silicate-bonded cores. A number of subsidiary problems arising in the course of the routine industrial application of this process has been studied. Work begun on the moulding properties of green-sands concerns the practical problem of the removal of a mould from the pattern and the ability of a bonded sand to conform to the surface irregularities of a pattern in the moulding process.

Analytical Techniques

The Association is continually engaged in the improvement of existing, and the development of new analytical methods for cast iron and related materials. The Methods of Analysis sub-committee of the Association has continued to examine co-operatively the standard methods of analysis for cast irons with a view to producing a standard publication of recommended methods.

Special attention has been paid to the chemical analysis of slags and similar material. Generally improved methods have been developed, particular attention being paid to the correct estimation of calcium and magnesium. In connection with the development of spectrographic methods of slag-analysis, a method has been developed for producing standard slags by means of a continuously recording thermal balance.

In view of their importance, a special investigation has been concerned with the analysis of trace elements in cast iron. Successful methods for determining minute amounts of lead and bismuth have been developed using the cathode-ray polarograph. Methods for the determination of traces of aluminium and boron are still under investigation. Considerable effort has been devoted to the development of methods for the analysis of used ethylene glycol anti-freeze solution.

Development Department

The success of the industrial liaison work of the development department is indicated by an increase in the number of problems received from industry of nearly 40 per cent. in the past 10 years. The tendency for engineering users to apply to the department for assistance is markedly increasing, and this trend has been encouraged by a conference held in November, 1956, devoted entirely to the engineering properties of cast iron.

Largely as a result of the activities of the Department, a Joint Cupola Coke Quality Committee has been formed by the Council of Ironfoundry Associations and the British Coking Industry Association, and a programme of work has been initiated. This committee, of which Dr. H. T. Angus is Chairman, includes representatives of the industries concerned. The Department is represented on the international committee on Testing Cast Iron. Considerable benefit is likely to be obtained by an exchange of information with continental foundries by means of this type of international co-operation.

Foundry Atmospheres Section

The Foundry Atmospheres section has carried out a great deal of work in members' foundries, advising, in particular, on the design of new knock-out equipment and dust control in fettling shops, and an increasing volume of work has been done on external air pollution; the introduction of the Clean Air Act has greatly increased the number of enquiries under the latter heading. The Department provided technical witnesses at the recent public enquiry relating to the operation of the Clean Air Act. It is also represented on a sub-committee (No. 9) of the European Committee of Foundry Associations, dealing with health hazards in the foundry.

Scottish Laboratories

The Scottish laboratories continue to carry out advisory work both for foundries and users of castings, and a short conference is planned to be held in Glasgow, primarily to interest users of castings in the services of the Association. There were 68 visitors to the Scottish laboratories during the year.

Operational Research Team

The Operational Research team has continued to visit foundries, by invitation, to examine existing procedure and to put forward recommendations for improvements. Particular importance is attached to lay-out and production methods and, on a few occasions, diagrammatic lay-outs for mechanized plants have been put forward. During the past year the Team has carried out 59 visits, of which 19 have been return visits at the request of the firms concerned. The number of visits since the Team's inception in 1950 totals over 700.

Close liaison has been maintained with the development department and the sands section on foundry problems arising during the course of the Team's work. Considerable interest has been displayed in operational and work-study techniques, and useful data have been collected and analysed in connection with the labour involved in cupola charging. Memomotion photography has been applied to the study of plate and snap flask moulding methods.

Intelligence Department

Publications

The *BCIRA Journal* has completed its sixth volume during the year under review and 38 reports have been published. The *BCIRA Bulletin* has completed its thirteenth volume and, in addition to the customary features, contributions have in-

cluded exhaustive surveys of the literature on desulphurization and the manufacture of cast-iron glass-moulds, together with a lengthy list of films available on foundry and related subjects.

Twelve external reports, contributed by members of the staff to outside bodies or technical journals, appeared during the year and have been made available to members. In addition, members of the staff gave 35 lectures to technical institutions, educational bodies and other organizations; this total includes five addresses by the director to trade associations, previously mentioned. In October, 1956, the director made a recorded contribution in French on the work of the Association which was broadcast on the BBC overseas programme.

Conferences

A highly successful conference on the theme "Engineering Properties and Uses of Iron Castings" which was attended by 246 makers and users of castings was held in London in November, 1956. This may provide a pattern for smaller future meetings between producers and users to consider narrower fields in which castings are used.

Enquiries

Enquiries dealt with by the department continued to show an upward trend. The library loans for the year totalled over 4,500, of which rather more than one-third represented requests from members. References to the Association's work in the technical and newspaper press totalled over 300.

An Azoflex copying unit has been installed in the department for the convenience of members and single photocopies of most of the material abstracted in the *BCIRA Bulletin* can be obtained by writing to the Librarian at Alvechurch. A nominal charge is made to cover the costs of reproduction in order to conform with the provisions of the Copyright Act, 1956.

Exhibitions

The Association has contributed to a number of private technical exhibitions organized by members and others. During the month of August, 1957, the Association co-operated with the Birmingham Exchange and Engineering Centre in the arrangement of a display at the Exhibition Hall of the Centre on the theme "Science in Ironfounding." An exhibit illustrating some of the means of controlling dust in foundry operations was contributed to the DSIR stand at the Safety and Factory Efficiency Exhibition held at Bingley Hall, Birmingham, in June, 1957. Material was also contributed to two other exhibitions, the first organized by the English Electric Company, Limited, at Stafford, February 4-11, and the second held by the DSIR on April 8 in London in connection with a survey of work carried out by research associations using Conditional Aid funds.

Foundry Education

The student apprentice scheme operated by the Association to provide a source of recruits to the staff has been further developed during the year under the supervision of Mr. E. R. Evans. The four-day courses on moulding- and core-sands for representatives of member firms meet a continuing demand; 44 such courses have been held up to the middle of 1957, with a total of upwards of 500 attending.

Close contact has been maintained with the National Foundry College and with the supervisor's courses sponsored by the Council of Ironfoundry Associations, now held three times a year at Tor Lodge, the NFC hostel near Wolverhampton. The Association participated in the Education and Training Conference held by the Council of Ironfoundry Associations, in November, 1956; the Director is a member of the CFA recruitment, training and education committee, of which Mr. Kenneth N. Davis is now chairman in succession to Sir Harold West.

Membership and Staff

The total membership of the Association in all classes at the end of September, 1957, was 1,310. The total staff was 138. The report is signed by Mr. J. J. SHEEHAN, the president; Mr. S. H. RUSSELL, the chairman of council, and Mr. J. G. PEARCE, the director.

CO_2 Sand Contamination

Founders who are concerned as to the possible deleterious effect on their green-sand system resulting from contamination by used CO_2-practice sand (JOURNAL, October 24, p. 502, 1BF, Slough section meeting report), may be reassured by the following extract from a letter received from a Manchester firm.

"Regarding the question of contamination of the green-sand system by spent CO_2 sand; we have, for some considerable time been using the spent CO_2 core sand in our system. It should, however, be made clear that only one sand is employed in the foundry, that is, Chelford. It can hardly be stated therefore, that we are contaminating our moulding sand with the core sand. Whilst we have not carried out any chemical tests to ascertain whether the sodium silicate has any effect on the moulding sand, we can state that it would appear not to have any deleterious effect—so far as casting finish and quality are concerned.

Canadian Trade Mission to Visit UK Industry

Canada's trade mission which will arrive in this country on November 22, will consist of upwards of 50 senior representatives of organizations interested in buying outside the Dominion. It will be led by Mr. Gordon Churchill, Minister of Trade and Commerce, with Mr. James S. Duncan, chairman of the Hydro-electric Power Commission of Ontario and of the Dollar Sterling Trade Council, as deputy leader.

The mission is the direct outcome of recent talks between Canadian Ministers, the Chancellor of the Exchequer and the President of the Board of Trade, and the purpose will be to assess the possibilities of generally increasing purchases from the UK and of obtaining from this country products previously purchased elsewhere. It is hoped the mission will see the most outstanding industrial and technical achievements of the UK.

AFS Practical Training Courses

A series of five practical foundry training courses, arranged with the object of upgrading foundry supervisors was scheduled this year as part of a special drive by the Training and Research Institute of the American Foundrymen's Society. The first course in this series took place on July 15 to 19, August 19 to 23, and September 9 to 13; it concentrated on laboratory sand-testing methods and took place at Rackham Educational Memorial, Detroit. Here, a completely-equipped laboratory was set up and the course was limited to twenty-five persons at a tuition fee of 100 dollars.

The second course was presented from September 16 to 20 and was entitled Foundry Sand Technology, I. This was in the form of a lecture course, given by the same instructors and in the same location as the laboratory course. Enrolment was limited to 200 and the tuition fee was 50 dollars. The second part, an advanced lecture course, is to be held from November 4 to 8. This is designed for sand experts and for men who have completed the first two sand courses. In this case tuition and enrolment limits are 50 dollars and 200 persons, respectively.

A course on "Foundry Cost Reduction through Better Methods and Performance Standards" was offered on September 23 to 27 at the Marquette Management Centre, Marquette University, Milwaukee. Development of this course was under the supervision of Dr. M. E. Mundel, vice director of the Centre, assisted by specially selected staff of foundrymen. Tuition was 120 dollars and enrolment limited to 25 persons.

The fifth course in this series has been arranged for December 2 to 7 at the Navy Pier Branch, University of Illinois, Chicago. The subject is to be "Cupola Melting of Iron" and prominent cupola experts (including such well-known names as Levi, Mathes, Wilder and Massari) will be engaged as lecturers. The course is limited to 25 persons and a tuition fee of 50 dollars is being charged.

Comment

This series of five courses is the first to be arranged by the AFS in a broad, long-range programme of what in America is termed "in-plant" training—in this country usually referred to as "sandwich" courses. Parallel in this country, for instance, are the IBF Foremen's Training Courses, the CFA Management Courses and, for practical men, the classes at the National Foundry Craft Training Centre. Also, the training given for young executives at the National Foundry College, Wolverhampton, though not exactly a sandwich course, does involve sponsorship of students by firms or organizations and requires that the students shall have basic works experience. As in this country, the movement in America is sponsored by the castings industry itself in terms of the industry's current and growing need for bringing the personnel already engaged in the industry into full familiarity with modern developments. From reports so far received from the US, it appears that this series of courses has been very well supported and full bookings for each of the five courses are announced. It is understood that the course of cupola melting has, in fact, been oversubscribed, and "repeats" are already envisaged.

AN ACCRA REPORT states that a British company, Baker, Bosley, Limited, is to establish an iron and steel foundry and rolling mill on the site of the Taquah and Abosso mines at Abosso.

Titanium Castings

For the first time in this country, small titanium castings are being produced as a result of a research and development programme initiated by the Metals Division of Imperial Chemical Industries, Limited, into the possibilities of this technique. The importance of titanium in the aircraft and chemical industries by reason of its strength, low density and excellent corrosion resistance is well known. The ability to produce complicated shapes in quantity to a single pattern by casting techniques offers obvious advantages, particularly in view of the relatively high first-cost of the metal.

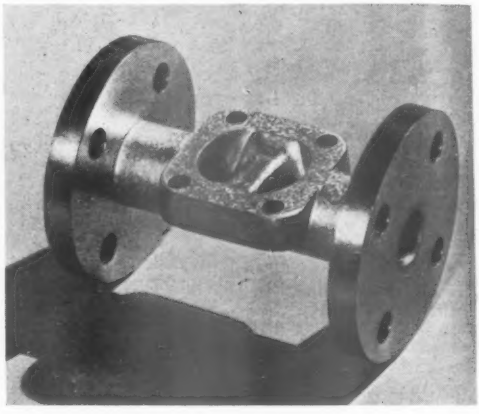


FIG. 1.—*One-inch, type "A" Saunders valve cast in I.C.I. titanium.*

In the production of shaped titanium castings, certain problems are encountered not normally experienced in foundrywork. Melting and casting must be done in a container large enough to allow all operations to be performed out of contact with air. Secondly, molten titanium reacts rapidly with all conventional moulding materials. Further, the gating and feeding arrangements for casting titanium differ from standard methods, as the time available for the molten metal to fill the mould before solidification is extremely short. In the technique developed, the operation takes less than ten seconds and results in sound, contamination-free castings.

One-inch type "A" Saunders valves (Fig. 1), an example of which was shown at the recent corrosion exhibition, are now being produced in prototype quantities for plant trials, and other chemical-plant components, such as impellers and nozzles, will follow.

Lister-Blackstone Subsidiary

Formation of a subsidiary to handle the rail traction applications of Lister and Blackstone diesel engines and other equipment is another step forward in a year which marks the 120th anniversary of Blackstone & Company, Limited, Stamford (Lincs), the 90th anniversary of R. A. Lister & Company, Limited, Dursley (Glos), and the 21st anniversary of the association of the two companies.

The subsidiary, Lister Blackstone Rail Traction, Limited, has its registered offices at Imperial House, 15-19, Kingsway, London, W.C.2.

New Foundry Departments . . . . . . for Thomas Crompton & Sons

For nearly 100 years the name of Crompton, in Yorkshire, has been associated with the production of hinges. Development of the concern has been rapid during the last few years, and this has led to inauguration of a rebuilding scheme for the foundries at Ashton-in-Makerfield, and to the erection of the new hinge factory and plating shops at Haydock, officially opened last April. The following article outlines some of the improvements which have been effected in the foundries and describes some of the plating processes as applied to castings.

The name of Crompton is first recorded in connection with the manufacture of hinges, as far back as the early 17th century, when, it appears, a certain Thomas Crompton was engaged in hand-making small quantities of hinges for domestic purposes. This craft was apparently handed down from father to son, more staff being taken on as required. The real development of the firm commenced in 1919, when a limited liability company was formed—Thomas Crompton & Sons, Limited. 1935 could be called the "year of independence" for the concern, for it was then that a hot-rolling mill was laid down, and it became self-sufficient from the point of view of raw materials.

During these years the company had decided to expand their field to embrace that of metal products for the building industry. This resulted in the erection of a grey- and malleable-iron foundry at Ashton-in-Makerfield (Fig. 1*a*), the latest improvement in which was the erection of a new grey-iron bay which went into production on Monday, April 8 this year (Fig. 1*b*).

The grey- and malleable-iron foundries are responsible for the company's output of small domestic and builders' castings which include a range of handles, clothes-hooks, letterboxes and window fittings, together with bolts, hasps, pulley-wheels and lock components. The rebuilding scheme comprised the erection and re-equipping of the malleable-iron casting bay, the sand plant, the patternshop, the raw-material storage bays and polishing, fettling, cleaning, drilling and assembly shops, together with the provision of amenities for the employees including showerbaths and locker facilities.

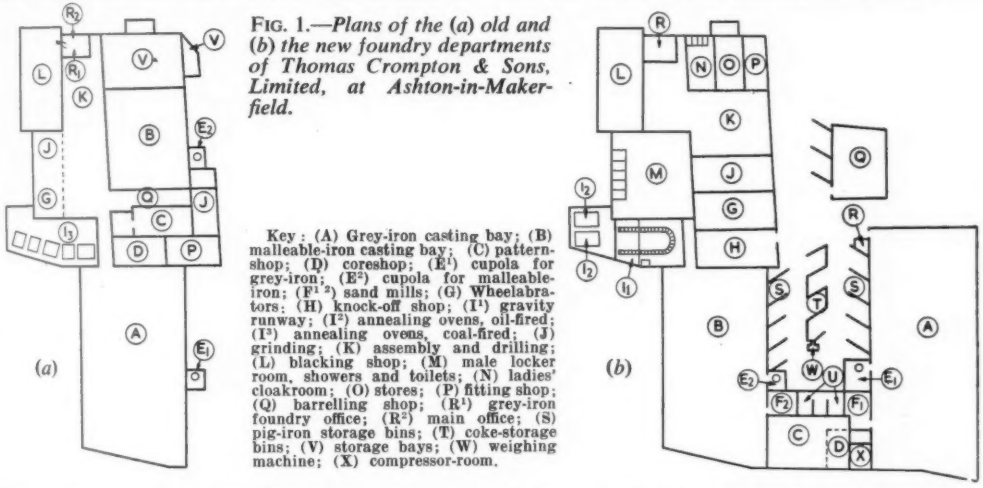


FIG. 1.—*Plans of the (a) old and (b) the new foundry departments of Thomas Crompton & Sons, Limited, at Ashton-in-Makerfield.*

Key: (A) Grey-iron casting bay; (B) malleable-iron casting bay; (C) patternshop; (D) coreshop; (E^1) cupola for grey-iron; (E^2) cupola for malleable-iron; ($F^{1\,2}$) sand mills; (G) Wheelabrators; (H) knock-off shop; (I^1) gravity runway; (I^2) annealing ovens, oil-fired; (I^3) annealing ovens, coal-fired; (J) grinding; (K) assembly and drilling; (L) blacking shop; (M) male locker room, showers and toilets; (N) ladies' cloakroom; (O) stores; (P) fitting shop; (Q) barrelling shop; (R^1) grey-iron foundry office; (R^2) main office; (S) pig-iron storage bins; (T) coke-storage bins; (V) storage bays; (W) weighing machine; (X) compressor-room.

Grey-iron Bay

The grey-iron casting bay is of brick construction with a floated-concrete floor. The roof, of double-span design, is fabricated of corrugated asbestos, with full bays length of patent glazing, ample ventilation facilities being provided. The layout of the new bay, which measures 180 by 80 ft., is simple but efficient. Green-sand moulding is carried out on Fisher and BMM pin-lift machines (Fig. 2), which are situated at the east, west and south walls of the bay—and Mansfield sand is used throughout. Because the products are small in size, the castings are moulded four, six, eight or ten castings per spray on each patternplate, with two feeder-heads, this number having been found by experience to be the minimum required to give sound results, owing to the thin sections cast. Completed moulds are laid out in rows and cast on the floor. Metal is obtained from a cold-blast cupola of 10 cwts. per hr. capacity, which is tapped through an opening in the west wall of the bay, and is carried to the moulds by means of hand-ladles (Fig. 3), which contain sufficient metal

FIG. 2.—*One of the pin-lift machines used for green-sand moulding.*

FIG. 3.—*Hand-ladle pouring of floor-banked moulds in Crompton's new grey-iron casting bay.*

for three boxes. At present the boxes are knocked-out on the spot, but it is hoped at a later date to instal a semi-automatic ventilated knock-out unit, and mechanical conveyor systems in the northern section of the bay.

Both the old and new casting bays are served by air from a new compressor room, and with sands from a new continuous sand mill (Fig. 4). The sand is transported from the mill-room to the moulding machines by means of rubber-tyred wheelbarrows, since it is felt that the small-tonnage output of these foundries does not necessitate complete or even partial mechanization. The rebuilding scheme will, however, provide better working conditions for the employees and a more continuous flow from department to department; this, it is anticipated, will produce a sharp increase in output.

FINISHING PROCESSES

After the boxes have been knocked out, the castings are separated and fettled and Wheelabrators are to be installed to speed up this stage of the production flow. Some of the products pass from the foundries in the fettled condition, whilst other components are drilled and machined before being polished in tumbler mills, preparatory to plating, or blacking.

Blacking Section

Castings which are to be despatched "black" are received by this department in the fettled, cleaned and if required, drilled condition. They are suspended on frames, either with wire, or from pegs,

FIG. 4.—*Feeder belt serving the new continuous sand mill. Milled sand is transported to the moulders by wheelbarrow.*

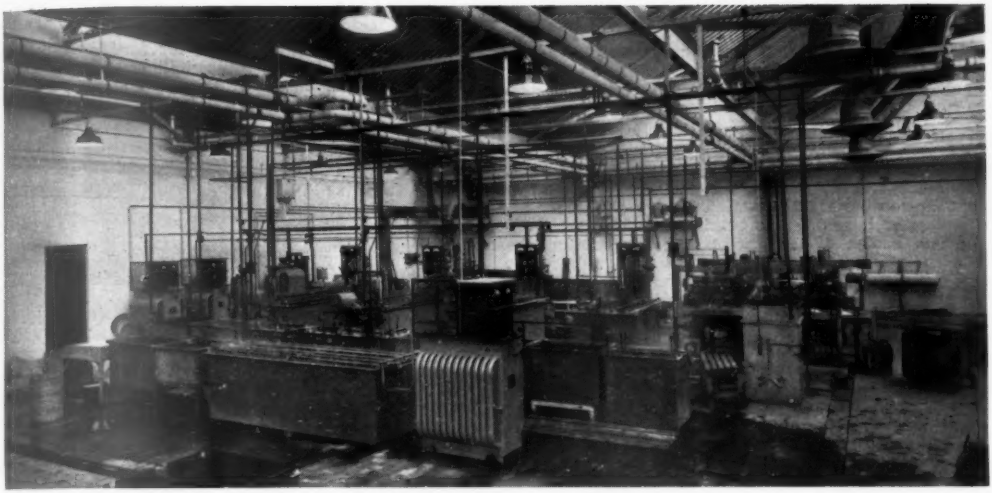


FIG. 5.—*View of the plating shop at the Haydock works where both castings and sheet-metal products are finished.*

and the frames are then loaded into a dipping machine which carries the components through a bath of the black-dip compound, and so through a small gas-fired oven. Finally, castings are inspected, sorted, packed and stored ready for despatch.

Plating

Situated in the new Derby works at Haydock is a well-ventilated and spacious plating shop (Fig. 5) where castings and sheet-metal products are treated. Castings are copper-, zinc-, or chrome-plated. Most of the castings are coated in still vats.

Nickel and Chrome

Three organic bright-nickel vats each 7 ft. 6 in. deep by 2 ft. 6 in. wide are used in conjunction with the chrome vat of similar size. Although efficient lip extraction is built on to the chrome vat, "Zero Mist" is added to the solution as an additional protective measure and to reduce chrome drag-out. The time cycle of operations in the nickel vats is 18 min. and 6 min., the chrome rate of deposition being in the order of 0.001 in. per 20 min. at 60 amp. per sq. ft. As a result of the wide variety on the shapes of the castings which are handled, the company wire-up the components on frames.

Copper

The two copper-plating vats are the same size as those for chrome, and contain the usual Rochelle type of cyanide copper. Agitation has been installed to facilitate experimental work which is in hand in connection with bright-copper deposition.

Zinc

A normal zinc-cyanide solution is used for zinc plating with the addition of brightening agents, this resulting in a lustrous deposit. Working at 30 amp. per sq. ft., the solution deposits 0.001 in. in 40 min. Two vats are available, but only one of these is at present in use.

After plating the castings are inspected and packed; despatch is simplified by the large loading bay which is situated adjacent to the plating shop.

GKN Acquisitions

Acquisitions on a share and cash basis worth just over £1,000,000 have been made by Guest, Keen & Nettlefolds, Limited. The total consideration is the issue of £299,388 ordinary stock of the company, and £327,337 in cash.

The concerns involved are:—L. H. Newton & Company, Limited, bolt, nut, and screw, etc., manufacturers, of Birmingham; its 100 per cent. subsidiary, Birwelco, Limited, engineers and steel fabricators, of Birmingham; and Brown Fintube (Great Britain), Limited, an associate of Birwelco. The management of the companies will continue as formerly, with Mr. S. A. Tippetts as managing director.

OEEC Zinc Production

Refined zinc production for OEEC producer countries—Austria, Belgium and the Belgian Congo, France, Germany, Italy, the Netherlands, Norway, and the United Kingdom—in September totalled 68,285 *tonnes*, compared with 69,497 *tonnes* in the previous month.

The breakdown into qualities in September was:—High-grade and special high-grade zinc (at least 99.95 per cent. zinc content), 25,611 *tonnes*; others (g.o.b., debased), 42,674 *tonnes*.

POLLARD BEARINGS, LIMITED, Ferrybridge, Knottingley (Yorks), has received orders worth $2,000,000 (£715,000) from the United States and Canada.

Foreign Economic Reports

The following extracts have been prepared from economic reports recently issued by the Export Services Branch of the Board of Trade at the end of October. In each case an attempt is made to include mention of trends which may influence foundry business.

Western Germany and Hungary: An agreement has been reached between the West German and Hungarian Governments on an exchange of goods between the two countries during the six months ending December 31. The list of goods which Germany can obtain from Hungary makes no mention of materials affecting the foundry industry beyond stating that aluminium ingots are "being borne in mind." List "B"—German goods permitted for despatch to Hungary—includes crude iron, presumably pig-iron, malleable, railway rolling-stock components, castings, and other cast-metal products of all descriptions to a total value of 8½-million DM. Entry into Hungary of cast-steel permanent-way material (but including vehicle springs), is permitted up to a value of 450,000 DM., and a wide range of other metal goods (some semi-manufactured) can be permitted up to a total of over 3½-million DM.

Netherlands and Poland: New trade arrangements covering the period August 1, 1957, to July 31, 1958, have been concluded between the Netherlands and Poland. The goods on the list of imports into the Netherlands from Poland include metal products, up to the value of Fl. 15,000,000, and under this heading appear ferro-tungsten, ferro-titanium, refined ferro-manganese, ferro-silicon, zinc alloys, blocks and powder, and pig-iron. Goods which may be imported into Poland from the Netherlands include non-ferrous metals, diesel engines, scientific and precision instruments and apparatus, ships' propellers, etc., to a value of Fl. 1,000,000.

Colombia: From Colombia comes a report that the French firm of Tissot & Company, which is already established in that country, is considering the possibility of constructing a galvanized iron-pipe factory (presumably to include fittings). Also, a new company with a capital of Ps. 1 million has been formed in Bogota under the auspices of Metalurgica Gran Colombiana for the production of pig-iron from ore. During August the cost of living continued to rise: the indices were given as "working class" 129.6; "Employees" 126.8 (Base line July, 1954 to June, 1955 100). The fiscal deficit in 1957 is expected to be Ps. 250 million.

Switzerland: During the first half of 1957 a record number of motor vehicles (39,031) were imported, the United Kingdom with 4,292 vehicles being the third largest supplier. Imports of agricultural tractors are to be liberalized at the latest by the end of 1960, possibly when the new customs tariff comes into force, though it is not expected that the increase in duty will be a serious barrier to imports. Switzerland's metal industry is expanding as are also the production of high-precision instruments and apparatus and precision machine-tools. With regard to the Common Market, the view has been expressed that although much attention was rightly being paid to hindrances to trade in the form of tariffs and quotas, much the most serious impediment to-day was the unbalance of payments, and this was a subject to which neither the Common Market nor the Free Trade Area discussions had yet provided an answer. Owing to the difficulties facing Swiss adherence to the Free Trade Area, Switzerland might have to consider remaining outside, unless certain Swiss *desiderata* were met. Four million Swiss francs are to be spent on modernizing and enlarging the premises of the European Office of the United Nations Organization, and although it is unlikely that there will be much scope for foreign participation in this work, the possibilities of supplying simultaneous interpreting equipment from the United Kingdom are being explored. Switzerland's chief customers and suppliers during July were Germany, imports to the value of 210,900,000 Swiss francs, exports 77,400,000; USA, 99,100,000 and 72,000,000; Italy, 84,900,000 and 46,100,000; France 87,300,000 and 44,900,000; Netherlands, 34,800,000 and 21,900,000; United Kingdom, 42,800,000 and 36,200,000; Belgium/Luxembourg, 29,800,000 and 20,700,000.

Brazil: According to Board of Trade figures, Brazilian exports to the United Kingdom in the period January to August, stood at a figure of £19,047,000 against £18,592,000 in the comparable period of 1956. Exports from the United Kingdom rose to £12,079,000 against £9,321,000 last year. New Tariff Law and Import regulations came into force on August 14, and importers are considering the effect they will now have on the landed cost of goods. The Export-Import Bank have granted a loan of US$2,500,000 to the Sociedade Tecnica de Fundicoes Gerais of Sao Paulo. The company, which operates the largest steel foundry in Brazil, has been granted the loan in order to complete its mechanization programme. It is this company which supplies engine block castings to some of the motor industry in Sao Paulo, including Mercedes Benz.

Current exchange rates are about 11.77 DM, 10.63 Dutch florins, 2.80 US dollars, 12.26 Swiss francs, and 16.7 Colombian pesos to the pound sterling.

ICI and Yorkshire Copper Join

The boards of the Yorkshire Copper Works, Limited, and Imperial Chemical Industries, Limited, have reached the conclusion that it would be wise to combine their activities in the copper and copper-alloy tube and plate industry in a joint enterprise on the basis of equal participation. They are therefore exploring methods of achieving such a combination.

ICI would contribute its new copper-tube factory at Kirkby, Liverpool (which is one of the most advanced in the world), the Allen Everitt copper and copper-alloy-tube works at Smethwick, Staffs, the plate factory at the Landore Works, South Wales, and the Fyffe fittings factory at Dundee. The Yorkshire Copper Works, Limited, would contribute its large copper and copper-alloy tube and fittings works at Leeds, together with its recently established manufacture of plastic tubes; also the tube factory at Barrhead in Scotland, the shell-moulding works at Castleford known as Anson Industries, Limited, and the controlling interests in Yorkshire Fittings (Australia) Pty., Limited.

The companies have between them extensive research and development, technical service, and sales facilities, and the deployment of these in a single enterprise will promote economy, efficiency, and service to customers. The plants of the two companies are in many instances complementary, and their utilization in a joint enterprise would enable production facilities to be used with the utmost efficiency the better to compete in vital overseas markets and in the likely Free Trade Area in Europe.

GOODENOUGH PUMPS, LIMITED, Byfleet (Surrey), has taken over Power Installations, Limited, chemical plant and hydro extractor, etc., manufacturers, of Leicester, which was established in 1924.

Crosfield's Extensions

Last week, Joseph Crosfield & Sons, Limited (one of the Unilever Group) held a reception in London to celebrate the completion of extensions (costing over £300,000), to their factory at Bow. The gathering was addressed by Dr. J. E. Taylor, chairman of the company, who explained that the production of sodium silicate in various forms was their chief concern. Hitherto, "soluble glass"—the result of firing together silica sand and soda ash—had been sent from the firm's main works at Warrington to the Bow works for crushing, solution and concentration into the saleable forms —including water-glass—for foundry CO_2 practice. The extensions at Bow, however, now embody a furnace installation for preparing soluble-glass there, and so make the works independent of supplies of material from Warrington.

Sand Drier

The equipment put in for handling raw sand at Bow has considerable interest for founders. As shown in Fig. 1, it comprises a rail-wagon tippler (by Strachan & Henshaw, Limited, of Bristol), which delivers the sand to a hopper below floor level from which the sand is automatically elevated by bucket and fed into a drum-type drier. This equipment, supplied by Edgar Allen & Company, Limited, has an output of about seven tons per hour, and is oil-fired. It consists of a rotating drum carrying a central tube through which pass the hot products of combustion, drying the sand—carried in the annular space—as it continually falls on to the tube. Dry sand drops into a pit at the further end, from which bucket elevators and a rubber-belt conveyor deliver it to a storage silo.

The new furnace at Bow was built by King, Taudevin & Gregson, Limited, who acted as main contractors for the whole extension, supported by the FC Construction Company, Limited, of Derby (civil engineering); Lambhill Ironworks, Limited, of Glasgow (structural steelwork), and Polysius, of Ascot (bulk soda-ash handling). Dr. Taylor expressed himself as very pleased with the services these firms had accorded.

Touching on an article appearing in last week's JOURNAL on the origins of the CO_2 Process, it is interesting to record that it was at William Gossage's works at Widnes, Lancs—associated with the Crosfield concern which was founded in 1814—that James Hargreaves patented a process in 1867 for the production of sodium silicate. Strange to relate, after a lapse of eighty years, a major requirement for silicate has arisen through the resurrection of the CO_2 Process in foundries, in which invention Hargreaves shared with his brother and Poulson, over 50 years ago.

News from Africa

Central African Federation

The Rhodesian Railways are to be financed by the Anglo American Rhodesian Development Corporation for a further £2,750,000 worth of new rolling stock. The search for uranium in the Federation is to be intensified, and an aerial survey covering 6,000 sq. miles of Southern Rhodesia for radioactive minerals is to be undertaken by the UK Atomic Energy Authority. In Nyasaland it is expected that an iron ore mine will be in production early next year, providing the final analysis of the ore proves satisfactory.

East Africa

In a bid to find minerals such as uranium, the United Kingdom Atomic Energy Authority, it is reported, is prepared to spend a considerable amount of money in Tanganyika and other parts of East Africa.

Nigeria

A revised scheme for developing the lead-zinc producing areas of Nigeria, owned by the Mines Development Syndicate, has been put before the Nigerian Government.

South Africa

Umgababa Minerals, Limited, an associate company of the Anglo American Corporation, will start production towards the middle of next year, of the heavy minerals—rutile, ilmenite and zircon. Ilmenite will be produced at the rate of 100,000 tons a year, while zircon and rutile will be recovered at the rate of 10,000 tons and 7,000 tons annually, respectively. The area to be mined is a five mile stretch of the Natal South Coast on the inland side of the Durban-Port Shepstone railway line.

A plant, estimated to cost £1,500,000, for the extraction of the heavy mineral concentrates, will be erected on a site between the South Coast National Road and the sea, and the plant and machinery, which were fabricated partly in the United States and partly in the Union, will be installed as soon as the buildings have been completed.

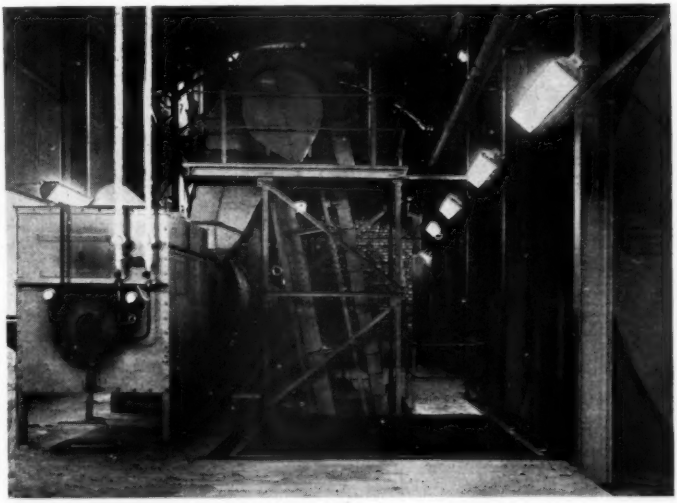


FIG. 1.—*Edgar Allen Rotary Sand Drier installed in Joseph Crosfield's extended factory at Bow. On the right is a part of the tippler for wagons of raw sand, the material containing up to 10 per cent. moisture as received.*

Notes from the Branches

Birmingham

A meeting of the Birmingham branch of the Institute of British Foundrymen was held at the James Watt Memorial Institute on October 23, when Mr. F. Gaiger, foundry superintendent at John Harper & Company, Limited, Willenhall, presented a paper entitled "The Case History of a Methods-improvement Programme applied to Foundry and Dressing-shop Operations."

The Author commenced with a brief summary of "tools" available to a methods engineer and went on to say that his paper would incorporate a summary of the results of a comprehensive survey carried out in the work-study department of his company's foundry. After defining the symbols used in work-study, he emphasized the fact that transport and storage are unproductive and costly. By means of using process charts for indicating the cycles of operations; flow sequences; material supply and personnel employment, it was possible to get a complete survey of all activities in a given factory. A comparison of throughput between different sections of the works would quickly show up any "bottlenecks." A foundry may have high overheads in certain sections; indirect costs may also be high, while moulding output may be low; in addition, there were many interferences which could cause hold-ups. Short-term measures could of course be taken to deal with a given set of circumstances, but for a permanent solution a summation of all available facts was required and the flow charts illustrated would help to give a clear picture of the cause of delays.

Duties of the Methods Engineer

A methods engineer had to investigate and record what was being done, by whom, and for what purpose, and he must also find out whether a given operation was essential or if it could be cut out or combined with another operation. These questions should also be applied to machinery and accessory equipment.

Production methods frequently could be improved by better arrangement of existing layout, more-efficient equipment, installation of mechanical aids, or the imposition of a completely new set-up utilizing new plant. It was essential, however, for a new method to be properly supervised to ensure that it was retained in proper operation.

By the use of films, analysed frame by frame, a great deal could be learnt about processes in a foundry. Another method of film recording was by the use of a memo-motion camera. The Author then went on to outline the changes which had been made by his company in the foundry, and particularly the dressing shop, since operations had been based on work-study principles. The dressing shop had been reorganized, output had increased, and the total labour force had been reduced by approximately 30 per cent. Yet, the output of the moulders and the degree of machine employment had risen by approximately 30 per cent. and labour utilization in the shotblasing department had improved by 300 per cent. In addition to this, changes in the dressing shop had made a considerable amount of floor-space available for other purposes. Mr. Gaiger concluded by showing a film illustrating the various improvements effected in these and other departments of the works.

In proposing the vote of thanks, Mr. M. M. Hallett said that foundrymen must not be scared of the terms used by methods engineers and concluded by asking members present to accord Mr. Gaiger a hearty vote of thanks. Mr. Hendry seconded this proposition and the meeting continued with a general discussion.

Law Cases

Successful Appeal for Rates Re-assessment

Factory premises described as "the cradle of the Industrial Revolution," were the subject of an appeal at a Smethwick Valuation Court by W. & T. Avery, Limited, who secured a rate reduction of their Soho Foundry. The firm maintained that because there was no room for expansion and that many of the buildings were old and had become redundant, the assessed net annual value of their factory was excessive. Mr. F. J. Shuttleworth, contract surveyor to the Inland Revenue, said his assessment was £25,750 and Mr. R. Hodgkinson, who represented the firm, asked that it should be £21,400. The court fixed the valuation at £23,500.

Mr. Hodgkinson said: "This is an historic building associated with the inventions of the pioneers, Boulton, Watt and Murdoch. It is no flight of fancy to say this was the cradle of the Industrial Revolution. This may not seem relevant to rating to-day but it indicates that here is a layout designed a very long time ago for an entirely different purpose and unsuitable for modern engineering." There had been much demolition and removal of plant to the firm's new factory at Tame Bridge, Wednesbury. "More of the Soho foundry may become redundant," Mr. Hodgkinson added.

Judgment against Slinger

Cox and Danks, Limited, iron and steel merchants, Stevenson Road, Sheffield, were defendants in an action at Sheffield County Court when a 29-year-old Arab labourer, Sayed Hassan Hamood, of Sheffield, claimed damages for injury. Hamood said he was told to act as a slinger at the works and one of his fingers was caught in a load being lifted by a crane. The finger had to be amputated at the first joint. A yard foreman Mr. William Favell, said that he never told Hamood to act as a slinger. The Court accepted the foreman's evidence ,and judgment was given for the firm.

Argentine Contract for Britain

Major share, stated to be worth over £30,000,000, of the contract for the construction of a large power station on the River Riachuelo in Buenos Aires, has been awarded to the British Thomson-Houston Export Company, Limited. in association with International Combustion (Export), Limited. The plant to be supplied includes five 120,000 kw. turbo-alternators, boilers and fuel handling equipment, transformers, switchgear, motors, and control gear.

The contract for the ancillary transformer substations has also gone to a British enterprise—Metropolitan-Vickers Electrical Company, Limited. It is planned to instal the first of five 120,000 kw. generators within three years and to complete the work a year afterwards. The cost of the whole undertaking is estimated at 5,000,000,000 pesos (between £40,000,000 and £50,000,000).

In association with the British partnership, an Argentine consortium of civil engineering contractors will carry out the civil works.

STURTEVANT ENGINEERING COMPANY, LIMITED—Mr. N. L. Millard, secretary, and Mr. C. W. W. Wheal, sales manager, have been appointed to the board as from January 1. Mr. Millard will continue as secretary.

Company News

EXPANDED METAL COMPANY, LIMITED—It is proposed to increase the authorized capital by £125,000 in order to effect the one-for-four capitalization issue. It is not intended to issue the balance of £87,231 of unissued capital at present.

BIRMID INDUSTRIES, LIMITED—Group net profits fell from £1,488,659 to £912,727. As before, the 10 per cent. dividend is accompanied by a 7½ per cent. bonus. After deduction of outside interests the profit attributable to the holding company is nearly £570,000 lower at £898,618.

YORKSHIRE AMALGAMATED PRODUCTS, LIMITED, sand and gravel quarry owners, of Doncaster—The Yorkshire Brick Company, Limited, has made an offer of 3s. cash for each of the 1,267,310 2s. shares. The companies are closely associated and the boards of both are identical.

CANNON HOLDINGS, LIMITED, ironfounders and makers of domestic gas appliances, chemical plant, etc., of Bilston (Staffs)—Group profit before taxation of £45,388 (£31,893) is £90,104 (£1,847). A final dividend of 10 per cent., making 15 per cent. for the year on the £300,000 ordinary capital, is to be paid, compared with a single payment of 10 per cent. for the previous year.

BROWN BAYLEY, LIMITED—The company announces an interim dividend of 2½ per cent. in respect of 1957. (Brown Bayley was recently formed as a holding company to take over Brown Bayley's Steel Works, Limited. Under the scheme the 300,000 ordinary 2s. 6d. shares of Brown Bayley's Steel Works were replaced by 2,400,000 ordinary £1 shares in the Brown Bayley holding company).

WALMSLEY (BURY) GROUP, LIMITED, papermaking machinery manufacturers, and iron and non-ferrous founders, etc., of Bury (Lancs)—The company announces a further increase of 2½ per cent. in the dividend, with a final of 22½ per cent. to make 27½ per cent. for the year to June 30, 1957, against 25 per cent. for 1955-56, and 22½ per cent. for 1954-55. Profits rose from £632,232 to £669,905, and after tax of £350,601 (£345,064) the balance is £319,304 against £287,168.

CONTACTOR SWITCHGEAR, LIMITED—The company is raising its final dividend from 12 per cent. to 14 per cent. to make 20 per cent. for the year to July 31, 1957, against 18 per cent., and proposes to make a free issue of one new 5s. share for every two held on December 3. The issue, which will necessitate capitalization of £100,000 of reserves, is not to be taken as an indication that the amount of future dividends will be increased. It is subject to CIC consent. Net profit was £76,698 (£65,084).

SPARK ALLOYS, LIMITED—It is proposed to create 1,000,000 "A" ordinary 1s. shares carrying the right on a poll to one vote for every five shares held. Part of the increase is in connection with the acquisition of the Swedish Turnery & Plywood Company, Limited, which has been granted an option to take up 200,000 "A" 1s. shares at 2s. per share. An extra-ordinary meeting is to be held to consider changing the name to Spark Holdings, Limited, increasing the capital to £100,000, and altering the articles.

LE GRAND, SUTCLIFF & GELL, LIMITED, drilling machinery and oilfield equipment manufacturers, of Southall (Middx)—Platt Bros. & Company, Limited, textile and general engineers, of Oldham, which already owns 59 per cent. of the company's ordinary capital, has offered to acquire all the outstanding ordinary at 9s. 6d. per 5s. share, cum dividend. The offer which will be recommended by the Le Grand board, will be conditional on acceptance by holders of nine-tenths in value of outstanding shares, such holders being not less than three quarters in number, or such lesser proportions as Platt's may think fit.

SOLAR INDUSTRIES, LIMITED (formerly the Aluminium Castings Company, Limited), Greenock—Protracted legal difficulties and deterioration of market conditions have compelled the postponement of the proposed conversion of the temporary loan (reduced to £100,000 during the year ended March 31) into redeemable cumulative preference shares. The arrangements, which had reached an advanced stage, for a rights issue or ordinary capital, has also been postponed until market conditions improve. Group trading profits declined to £429,512 (£508,458) and no dividend is being paid on £400,000 ordinary capital in order to conserve resources.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

780,126. D. M. Morgenstern, 21111 Edgecliff Boulevard, Euclid, Ohio, USA.

Economical and commercial method and apparatus for die-casting under vacuum.

780,223. National Lead Company, 111, Broadway, New York, 6, N.Y., USA.

Metal casting dies for die-casting machines. The invention relates more specifically to a novel construction for the indirect cooling or heating, as desired, of large die surfaces.

780,290. Quebec Metallurgical Industries, Limited, 88, Metcalfe Street, Ottawa, Canada.

Stainless-chromium steels, and in particular those which are suitable for the production of surgical instruments.

780,633. Canton Chaplet and Manufacturing Company, 334 Third Street, Southeast, Canton, 2, Ohio, USA.

A novel device for affecting the rate of cooling and shrinkage throughout these operations, of a casting having substantial mass. It consists of a channel or trough-shaped body having divergent legs (or legs connected by a transversely-curved base). The end surfaces of the body are inclined away from the base. A prong or prongs extends from one or both ends of the base.

780,701. Christiana Spigervwerk, Nydalsveien, 1, Nydalen, Oslo, Norway.

A tong ear mould for use in casting ingots having an easily removable lining of heat-resistant material whereby the bottom and walls of the mould are protected against attack from the jet of molten metal cast into the mould.

780,920. Dow Chemical Company, Midland, Michigan, USA.

Apparatus for dispensing charges of molten metal to a casting device. It is intended specifically with regard to an apparatus for dispensing a series of equal size charges of a molten readily-oxidizable metal (such as magnesium-alloy) from a supply to a die-casting machine.

Personal

Black & Decker, Limited, announce that Mr. DOUGLAS BROWN has been appointed as marketing manager.

Mr. H. W. EASTERBROOK has been appointed a director of Foundry Mechanisations (Baillot), Limited, of Bletchley, Buckinghamshire.

The Royal Society of Health announces that LORD COHEN OF BIRKENHEAD has accepted nomination as president of the Society in place of LORD PERCY OF NEWCASTLE.

Mr. ARTHUR W. J. PETTIT has been appointed resident factory representative for Guy Motors, Limited, in East Africa and will shortly leave for Nairobi, where he plans to settle.

Mr. FRANK GRATTON recently completed 50 years in the Grimesthorpe foundry of the English Steel Corporation, Limited, where for many years he has been foreman moulder.

Mr. C. R. ADDISON, of Wednesbury Technical College, has been appointed head of the department of mechanical production and civil engineering at Rotherham College of Technology.

Mr. LESLIE JULL, production director of Lec Refrigeration, Limited, has been appointed joint managing director with Mr. CHARLES PURLEY, the chairman. Mr. WILLIAM GILLETT, works manager, has joined the board.

Mr. CHARLES H. CRABTREE, chairman of the Crabtree Foundry Company, Limited, has made a donation of 200 guineas to the Printers' Pension Corporation, which held its 120th Festival Dinner in London on November 6.

Mr. WILLIAM WALKER has been appointed managing director of the Atlas Steel Foundry and Engineering Company, Limited. He succeeds Mr. ROBERT SCOTT, who has resigned as managing director, but remains on the board.

Mr. FRANK WILLIAMS, a director and technical consultant for Markham & Company, Limited, of Chesterfield, has returned to Chesterfield, after a 40,000-mile round trip to Australia and New Zealand, which has occupied seven months.

Mr. F. M. COPHAM and Mr. CHARLES LARKING, secretary and general sales manager respectively of E. Green and Son, Limited, have been appointed directors. Mr. E. BASIL GREEN has resigned from the board after nearly 70 years' service.

Mr. H. NICHOLSON has been appointed chairman and Mr W. J. LEE managing director of Hattersley (Ormskirk), Limited, manufacturers of engineering fittings, Ormskirk and Halifax, following the retirement from those posts by Mr. THOMAS HEAP.

Mr. W. A. HARDMAN has been appointed manager of the Eastern division of the Metropolitan-Vickers Electrical Export Company, Limited, covering an area including India, Pakistan, China, Malaya and Ceylon. He succeeds the late Mr. R. V. D. KIRBY.

Mr. H. B. HALLSWORTH, inventor of the "Hallsworth" automatic moulding unit, has resigned his position with the Rubery Owen organization and has been appointed production and development director of Platt Malleable Castings, Limited, Clive Foundry, Leamore, Walsall.

Mr. A. C. RUSSELL, Sheffield district manager of the British Thomson-Houston Company, Limited, for 12 years, was presented with gifts from managers and staff on his retirement at the Grand Hotel on October 22. The presentations were made by Mr. G. H. CLIPSTONE who has worked for 38 years with Mr. Russell.

Mr. F. T. BAGNALL, manager of the electric melting shop of Samuel Fox, Limited, Stocksbridge, addressed a joint meeting of the Sheffield Metallurgical Association, the Iron and Steel Institute, and Guild of Electric Steel Melters at the Hoyle Street headquarters, Shalesmoor, Sheffield, of the British Iron & Steel Research Association. He spoke on the place of the electric steel furnace in present and future steel production.

Leaving this country on November 18 to visit East and West Africa, Mr. J. D. MAY, export sales manager of George Kent, Limited, of Luton, will be meeting customers and agents in these territories to discuss and study the possibilities for future sales expansion of the firm's products. Flying first to Nairobi, Mr. May will later go on to Uganda and Tanganyika before travelling to Angola, Nigeria, and Ghana in December.

Mr. GEORGE WEST, assistant manager of the export department of the chemicals division of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, left by air on November 3 for a three-month business tour of 20,000 miles through the Commonwealth and Far East. He will visit agents and prospect developing territory. Many of the agents were appointed by his father, Sir Harold West, on a similar trip 30 years ago.

Mr. R. E. LUCAS, foreman patternmaker with the English Steel Corporation, Limited, has retired after 51 years service with the firm. A presentation dinner, given by workmen in the patternshops of the firm, was held on October 25 when he was presented with a gold watch, and a travelling clock for his wife. Mr. Lucas was awarded the B.E.M. in the 1950 Honours List and has been chairman of English Steel sports club for eight years and of the bowls club for ten years.

Sir ARCHIBALD FORBES, who has been chairman of the Iron and Steel Board since its establishment in May, 1953, has informed the Minister of Power that he would like to be relieved of this office—which he originally undertook for two years—now that the Board have presented their report on the proposed future development of the industry. The request has been agreed to, but Sir Archibald has consented to remain in office for a few more months to wind up certain matters.

Obituary

The death has taken place of Mr. ROBERT F. PROVAN, assistant managing director of Russells Brass Foundry, Limited, Motherwell.

The death occurred on October 24 of Mr. WILLIAM VARLEY, at the age of 64. The younger son of the late Mr. John Varley, founder of Varley (Skipton), Limited, engineers and ironfounders, Providence Works, Skipton, Mr. Varley was himself a foundry manager until his retirement on account of ill-health and also a director of the firm.

The death has occurred of Mr. JAMES SMITH, organizer of the Royal College of Science and Technology, Glasgow. From 1926 he had been associated with technical education in Scotland and was awarded the O.B.E. in 1953 for his services in this sphere. He was also secretary of the Scottish section of the Institution of Mechanical Engineers and a pioneer of the teaching of production engineering. He was 70.

Forthcoming Events

NOVEMBER 11

Institution of Works Managers

Manchester branch: Industrial Efficiency and Productivity Exhibition, 3 p.m., at the City Hall.

Incorporated Plant Engineers

Merseyside & N. Wales branch: "Industrial Lubrication," by G. Scott, 7.15 p.m., at the Blossoms, City Road, Chester.

NOVEMBER 12

Institute of British Foundrymen

Coventry and district section: "Practical Foundry Techniques," by Harold Haynes, 7.30 p.m., at the Coventry Technical College, Room A.5.

Slough section: Afternoon works visit to Trucast, Limited, Farnham Royal Lodge; evening meeting also at Trucast, when a paper, "Precision Investment Casting compared with other Foundry Processes," will be presented by L. N. Smith and L. N. Hocking, 7.30 p.m., at the Lecture Theatre, High Duty Alloys, Limited.

Incorporated Plant Engineers

Manchester branch: "Nuclear Power," 7.15 p.m., at the Engineers' Club, Albert Square (Joint meeting with the Institution of Heating and Ventilating Engineers.)

NOVEMBER 13

Institution of Production Engineers

Manchester graduate section: "Automation and Mechanical Handling," by F. T. Dean, 7.15 p.m., at the Reynolds Hall, Room C.3, College of Science & Technology, Sackville Street.

Dundee section: "Quality Control," by G. S. Sharp, 7.30 p.m., at the Timex Works, East Kingsway.

NOVEMBER 14

North-East Metallurgical Society

"Fatigue," by N. Thompson, Ph.D., 7.15 p.m., at the Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.

Institute of British Foundrymen

Northampton and district section: Two films on foundry subjects, 7.30 p.m., at the Coffee Room, Plough Hotel, Northampton.

Beds/Herts section: Topical technical films, 7.30 p.m., at W. H. Allen & Sons, Limited, Bedford. (Details from secretary.)

Southampton Metallurgical Society

Three films of Scientific interest, 7.15 p.m., at Southampton University.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

IRISH REPUBLIC, November 13—Supply of stores including crucibles and foundry requisites. (ESB/25781/57.)

INDIA, November 15—3-in. socket and spigot spun-iron pipes. (ESB/25862/57.)

PAKISTAN—Khwaja Khwaja & Company (Pakistan) Limited, wish to receive quotations as soon as possible for textile-printing machinery and equipment. (ESB/25957/57.)

SALVADOR, November 14—Galvanized-iron pipes and accessories. (ESB/25992/57.)

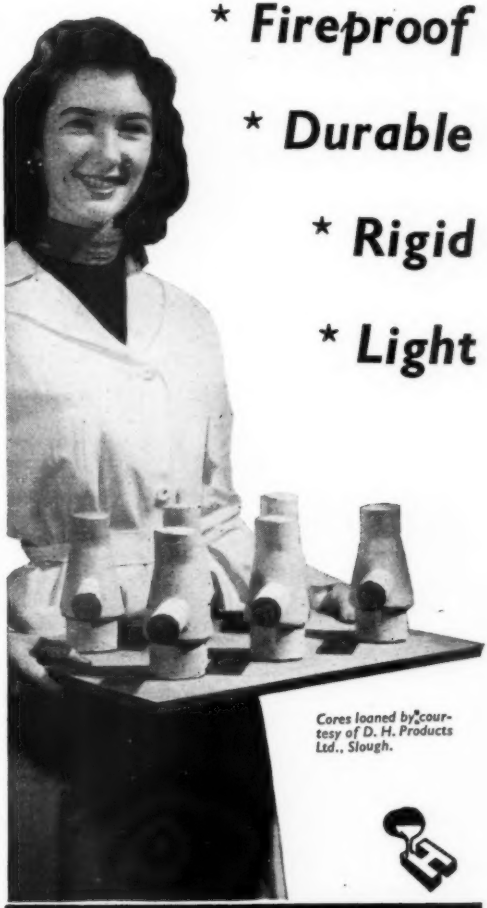
IRAQ, November 25—Cast-iron pipes, specials and valves. (ESB/25216/57.)

ALTRINCHAM, November 30—Main sewerage and sewage disposal at Altrincham for T.C. Works include the construction of approximately 1,780 yd. of 51-in. to 21-in. concrete and spun-iron sewers, storm overflow pipes, manholes, etc.; the laying of about 800 yd. of 9-in. spun-iron pumping mains, and other appurtinant works. Applications to D. Balfour & Sons, consulting engineers, 131, Victoria Street, Westminster, S.W.1. Deposit £10, cheque payable to the Council.

THE DIRECTORS of the Caterpillar Tractor Company (of America) have decided to raise additional funds through the sale this month of sinking fund debentures worth $65,000,000.

HOOKERLITE CORE TRAYS are

* Economical
* Fireproof
* Durable
* Rigid
* Light



Cores loaned by courtesy of D. H. Products Ltd., Slough.

W. J. HOOKER LTD.
239a FINCHLEY ROAD, LONDON, N.W.3
Phone: Swiss Cottage 3281-2-3

News in Brief

A SUBSTANTIAL INTEREST in an Australian concern, Trojan, which manufactures garden tools, has been acquired by Spear & Jackson, Limited, Sheffield.

THE REFINED IRON COMPANY (DARWEN), LIMITED, are now producing a high-carbon, low-manganese pig-iron which should be of particular interest to roll manufacturers.

THE FIRST ore carrier to be built by Short Bros., Limited, Sunderland, is to be launched this week. She is the 9,300-ton Clarkavon, on order for H. Clarkson & Company, Limited, London.

CONTRACTS totalling nearly £250,000 for six-wheeled 16,000-litre tanker vehicles, required for fuel distribution through the mountainous country of Iran, have been placed with Leyland Motors, Limited, by the National Iranian Oil Company.

THE SHAREHOLDERS attending the annual general meeting of Smith & Wellstood, Limited, Bonnybridge, were asked through a questionnaire to record their opinion of the colours proposed for use on a new solid-fuel-fired cooking stove to be placed on the market next spring.

THE AMERICAN FOUNDRYMEN'S SOCIETY announced that in connection with their 62nd. Congress, they are staging a foundry plant and supplies exhibition. This is to be held in Cleveland, Ohio, from May 10 to 23 next year. The first non-American firm to apply for space is Foundry Equipment, Limited, of Leighton Buzzard.

THE RAPIDLY DEVELOPING TECHNIQUE of spark-machining is the subject of a new 16 mm. colour film, "The Wickman Erodomatic," produced by Wickman, Limited, of Coventry. Copies of the film, which carries a fully descriptive commentary, will be available for loan in the near future, and a companion booklet is in course of preparation.

BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, Loughborough, handed over the first of 20 diesel-electric locomotives to British Railways on October 31. The 104-ton, 1,250-h.p. locomotive was formally handed over by Mr. G. C. R. Eley, chairman of the Brush company, to Sir Reginald Wilson, chairman of the Eastern Region Board.

A CONTROLLING INTEREST in G. S. Tett & Company, Limited, water softening engineers, of Feltham (Middx), has been acquired by the Pulsometer Engineering Company, Limited, Reading. Mr. F. B. Duncan and Mr. J. S. Woodrow, chairman and managing director, respectively, of Pulsometer Engineering, have joined the board of G. S. Tett & Company.

ENGLISH STEEL FORGE AND ENGINEERING CORPORATION, LIMITED, Sheffield, are supplying three giant generator shafts for a hydro-electric project in Sweden, at the Swedish Power Board's new power station at Stornorrfors. Each shaft has a flange diameter of 6 ft. 3 in. and is designed to rotate at 125 r.p.m. The total weight of the three, when completed, will be about 500 tons. The generators themselves will be the largest in the world.

AT THE ANNUAL GENERAL MEETING of the Scottish section of the Institute of Vitreous Enamellers recently held at Stenhousemuir, near Falkirk, Mr. Robert N. Watters was elected chairman in succession to Mr. Fyffe Smith who has resigned owing to his departure to South Africa; Mr. John Craig and Mr. John Anderson were elected to the committee. A paper on "Heat-resisting Enamels" was presented by Mr. Bob Zick, of Ferro Enamels, Limited.

THE INAUGURAL MEETING of the recently-formed Powder Metallurgy Joint Group of the Iron and Steel Institute and the Institute of Metals, will be held on December 4, at Church House, Great Smith Street, London, S.W.1, at 10.30 a.m. A lecture by the chairman of the Group, Dr. Ivor Jenkins, on "Recent Developments in Powder Metallurgy," will be followed by a discussion on "Developments in the Production and Quality of Metal Powders," based on a series of short introductory papers.

AGAINST STRONG INTERNATIONAL COMPETITION, Steel Structures, Limited, a subsidiary of John Howard & Company, Limited, civil engineers, of London, S.W.1, has obtained an order for a mobile oil-drilling platform, the first to be built in Britain. The contract, which came from the Delong Corporation of America, is expected to earn over £357,000. The 3,000-ton platform will be self-contained with air-conditioned accommodation for 30 men, and will be capable of drilling down to 15,000 ft. below the sea bed.

BOOTS PURE DRUG COMPANY, LIMITED, has completed negotiations with Solartron Electronic Business Machines, Limited, Thames Ditton (Surrey), for the purchase of the first production model of the newly invented Solartron electronic reading automaton (ERA). ERA converts printed figures into electrical impulses and feeds them direct to a special purpose electronic accumulator, which prints the totals required for accounting and statistical purposes. The reading speed of ERA is 200/300 characters per second.

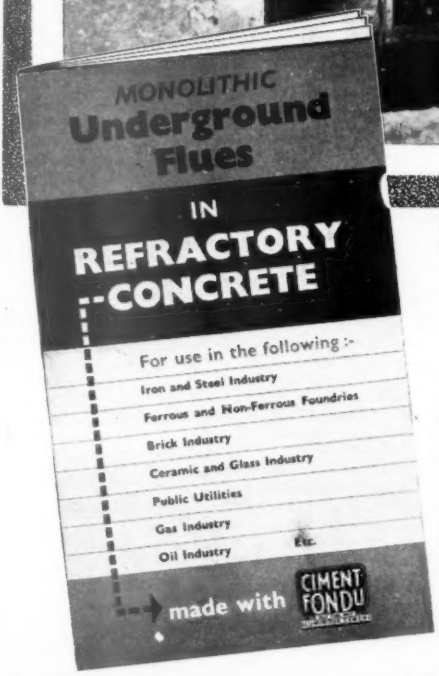
AN ENLARGED AND MODERNIZED block of offices at the Coborn works and depot, Tinsley, Sheffield, of the George Cohen 600 Group, Limited, was opened last week by Mr. Felix L. Levy, a director of the group and managing director of its raw materials division. The Sheffield branch of the company was opened over 40 years ago and the present site was occupied in 1934. The new portion of the block of offices embraces, among others, the raw materials division, steel department, machinery division, and the non-ferrous department.

A MERGER is proposed between Qualcast, Limited, and H. Kaufmann, Limited, domestic and garden appliance manufacturers. The amalgamation will be carried out by means of a share exchange. Holders of Kaufmann ordinary 5s. shares are to be offered five Qualcast 5s. shares for every four held. The board of Kaufmann intends to declare the usual interim of 5 per cent. on the ordinary before the proposals are sent out. On the basis of recent Stock Exchange quotations for Qualcast shares, the value of the offer is around £1,200,000.

RUSTON & HORNSBY, LIMITED, Lincoln, announce the establishment of an hydraulics department. The new department, located at the Anchor Street Works of the company, will be responsible for engineering control of fuel-injection equipment of Ruston & Hornsby design, manufactured at their Anchor Street Works, together with allied products. Mr. E. R. Groschel, who has been appointed engineer-in-charge was formerly manager of the advanced research department, Clayton Dewandre Company, Limited, Lincoln, and, prior to that, chief designer of Bryce Berger, Limited.

THE INSTITUTION OF CHEMICAL ENGINEERS has joined the European Federation of Chemical Engineering. The objective of the Federation is "the furthering of

(*Continued on page 566*)



Refractory Concrete monolithic flue in course of construction. Note movable former centred in trench.

Send for a copy of this interesting booklet dealing with the construction of MONOLITHIC FLUES

We invite you to visit us on STAND 64 Row D, Grand Hall, at the Building Exhibition, Olympia, November 13th - 27th.

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AP/1398

News in Brief

(*Continued from page* 564)

European co-operation in the field of chemical engineering, which includes chemical apparatus and equipment, chemical process technology, materials as applied in the industry, and basic chemical operations." The Federation now has secretariats as follows:— Dechema, Deutsche Gesellschaft für Chemisches Appatewesen, in Frankfurt am Main; the Institution of Chemical Engineers, in London; and *Société de Chimie Industrielle*, in Paris.

SHEFFIELD TRADE has not so far felt the impact of the present monetary policy, states *Quality*, the magazine of Sheffield Chamber of Commerce, but adds that there were fears of a reduction in demand. It says, "The possibility of some recession of world trade must always be in steelmakers' minds, but it would be wrong to imply that there was any feeling of pessimism among them. The immediate Sheffield area is much concerned with steel of kinds needed for essential purposes, so might well be more fortunate than some other areas if trade did decline to any noteworthy degree either at home or generally."

PRIOR TO THE LECTURE to be given to the West Riding of Yorkshire branch of the Institute of British Foundrymen on November 9 at the Bradford Institute of Technology, there will be a presentation of prizes, at 6.15 p.m., to the winners of the patternmaking section of the apprentice competition organized by the branch; the winning patterns will be on view from 5.30 p.m. A special plea is made to members to give their full support and to take along as many apprentices as possible. The paper to be presented to the meeting will be by Mr. D. H. Scott, who will be talking about "Mechanical Aids to Shell Moulding."

TUBES, LIMITED, Aston, Birmingham, a subsidiary of Tube Investments, Limited, achieved a 36 per cent. improvement on its average accident rate for the last two years during the first six months of this year. Only eight accidents were reported among its 1,000 production workers. The Tube Investments safety shield for factories with more than 500 workers, which is competed for by 20 companies in the group, was presented to the works director of Tubes, Limited, Mr. R. Scott Robinson, last month, by Mr. F. R. Salmon, the group's director of personnel. The shield, which is awarded every six months, was last won by the company five years ago.

CONCURRENTLY with the second conference on the Peaceful Uses of Atomic Energy, sponsored by the United Nations Organization, to be held in Geneva from September 1 to 14, 1958, there will be staged a commercially-organized international exhibition in the Palais de Expositions, Geneva. NETAC (Nuclear Energy Trade Associations' Conference) has undertaken the responsibility of co-ordinating the applications for space from UK participants so that an impressive British section of the exhibition may be staged. Experts and others with an especial interest in nuclear energy will attend the conference on a world-wide basis so that the British section in the exhibition affords an opportunity to demonstrate that Britain continues to lead the world in the development of the peaceful uses of atomic energy. Further information about the exhibition may be obtained from NETAC at 32, Victoria Street, London, S.W.1.

Exhibition Briefs

Below are listed some of the products of interest to the foundry industry which will be on show at the forthcoming Building Exhibition at Olympia, London, from November 13 to 27.

PURIMACHOS, LIMITED, of Bristol (*stands* 605 *and* 607), are featuring fire cements of various grades for domestic and industrial uses.

AERO RESEARCH of Duxford, near Cambridge will be displaying (*at stand* 602, *National hall*), urea-formaldehyde and resorcinol formaldehyde g.ues, together with epoxy resins, in their role as structural adhesives.

R. A. LISTER & COMPANY, LIMITED, of Dursley, (Glos) will be showing their LD2 Auto-Truck power-unit, driven by a twin-cylinder air-cooled diesel engine of 7 b.h.p. output at running speed of 1,800 r.p.m. The unit, installed in a complete truck, will be featured at the stand.

THWAITES ENGINEERING COMPANY, LIMITED, of Leamington Spa, will be exhibiting at *stand 415, Row H*, their hydraulic-controlled dump-truck, the 1½-cub. yd. Tusker dumper, and the 15-cwt. Nimbus dumper. The hydraulic-controlled dump-truck will be on show for the first time in Britain.

LAFARGE ALUMINOUS CEMENT COMPANY, LIMITED (*stand* 64, *row D*), will be illustrating the various applications of ciment fondu, in corrosion-resistant concrete, refractory concrete and insulating concrete, for all three of which it can be used. Typical examples of each use will be on show.

COLT VENTILATION, LIMITED, of Surbiton, Surrey, beside being responsible for the ventilation installation at Olympia itself, will be exhibiting a range of dual-purpose fusible-link heat and smoke exhaust ventilators. The majority of the equipment is manufactured in a high-grade aluminium alloy.

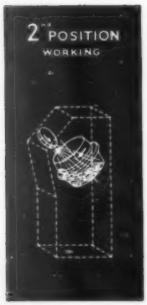
NEWTON, CHAMBERS & COMPANY, LIMITED, of Thorncliffe, near Sheffield (*stand M* 204) will be showing a wide range of Redfyre heating appliances for solid fuel and oil-firing, intended mainly for domestic building. These will include the No. 4A large capacity Bacboiler, an improved version not before on public show, the 55 continuous-burning fire, the self-contained Boiler Flue, the new open-convector fire and a range of oil-fired space and water heaters.

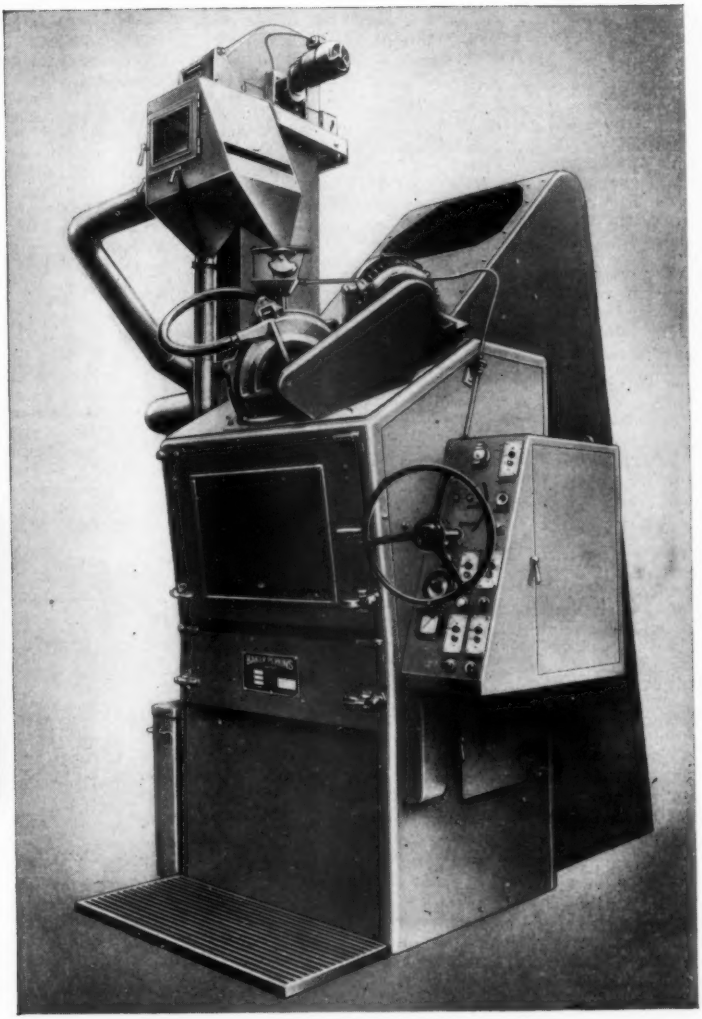
EXPLOSIVE POWER TOOLS, LIMITED, of Dukinfield, Cheshire (*stand 405, Row L*), will exhibit a bolt for use on steel which cannot be drawn out even when fired into steel plate $\frac{3}{16}$-in. thick. A feature of the design is that the shaft of the bolt is threaded in such a way that it remains undamaged when fired through mild steel, enabling a suitably tapped nut to be screwed into the shaft. Advantages of the bolt are that it eliminates drilling of steel, gives positive watertight fix, is not affected by vibration normally applicable to traditional bolts of relative size and strength and, finally, can be used in standard tools.

IT IS HOPED that a Royal Naval midget submarine will visit the river Nene in November, to allow employees of F. Perkins, Limited, Peterborough, to see it. The company builds diesel engines for the submarines.

BAKER PERKINS Shot Blast Equipment

Rotating Barrel Shot-Blast Machine





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Engineers
WESTWOOD WORKS – PETERBOROUGH

Raw Material Markets

Iron and Steel

In many sections of the ironfoundry trade, activity is concentrated chiefly on securing additional business in order to keep plants occupied for a full working week. The light, jobbing, and textile foundries are all in need of more business and some are compelled to remain on a four-day working week. The light foundries appear to be most affected, and the amount of work on hand is disappointingly low.

The foundries which rely mainly on the domestic utensil and building trades for their orders for castings have for some time been subject to fluctuations in business brought about by credit and other restrictions. With the possibility of a further squeeze the prospects are not very bright. On this account the demand for high-phosphorus pig-iron continues low and producers are unable to dispose of all their outputs. The foundries are buying cautiously and there is little forward purchasing.

The engineering and speciality foundries are better off and are delivering appreciable tonnages of high-duty castings to many trades. The motor vehicle makers take up increasing tonnages of castings, and demands for castings seem likely to continue at a good level for many months ahead. These foundries are taking up appreciable tonnages of low-phosphorus pig-iron and hematite, and makers are able to meet most of these demands—apart from some grades of low-phophorus irons which are none too plentiful. Hematite pig-iron is in good supply, as are the refined grades, and makers of both irons could serve a greater demand.

All grades of pig-iron are available for export when orders and licences can be obtained. There is little of the low-phosphorus irons to spare, but fairly good tonnages of other grades are available, and the orders which are being received are obtained against strong competition from producers abroad, many of whom are in a similar position. The makers of basic steel-making pig-iron are able to dispose of most of their production, but there is a slackening in the demand from the steelworks.

Most of the foundries have adequate supplies of scrap, including the heavier and better grades of cast-iron scrap, for which there is a fair demand. The scarcity of Welsh foundry coke is increasing the commitments on other ovens, from which many foundries are endeavouring to make good the shortage. Current supplies are generally sufficient, but there is little to spare. Ganister, limestone, and firebricks are readily available.

While most of the re-rollers are fairly well employed, capacity is not fully taken up particularly for small bars and light sections, demands for which continue on a reduced scale. Reinforcing rods are in heavy demand, and sheet re-rollers also have satisfactory order-books. Home steelworks are able to offer adequate tonnages of steel semis; there are tonnages to spare, particularly in the smaller sizes of billets. Arisings of defectives and crops at the steelworks are difficult to sell, as sufficient quantities of prime material can be obtained and the price-differential offers no inducement to the re-rollers.

Non-ferrous Metals

American buying of copper at the beginning of last week, reinforced by encouraging remarks made by the chairman of the Anaconda Copper Company, was sufficient to induce a change of sentiment in London, with the result that the LME quotation was raised some £13 above its lowest point. However, by the end of the week lack of any real consumer buying, plus continued heaviness on Wall Street, sent the LME price into reverse so that most of the week's gains were lost.

Mr. Glover, chairman of Anaconda Copper, influenced the market with his statement that actual consumption of copper is larger than indicated by deliveries of refined metal, and that the process of eating into stocks is about completed. This situation led him to believe that the copper market will soon be confronted with the problem of insufficient production rather than insufficient demand. If Mr. Glover is right and copper is being steadily absorbed in quantity in the US, the result will soon make itself felt in the price on both sides of the Atlantic. In fact, after the initial flurry of US buying last week rumours were strong that the custom smelter price would be raised from its present level of 25½ cents a pound. With the producers' price remaining at 27 cents a pound, UK copper can, and is, being purchased and shipped to America, and this form of arbitrage business may help materially to provide a floor to the present price levels.

Tin is featureless, with the cash price remaining more or less at the floor level of £730 a ton, although three months' metal is some £15 a ton cheaper. In the US the market is quiet, with the price wavering around 90 cents a pound.

Lead is taking its cue from the copper market and is fluctuating accordingly, but only moderately. Demand is firm on both sides of the Atlantic. In the US the price is 13½ cents a pound.

Zinc, after its recent show of firmness is somewhat easier, although improved demand for high-grade zinc is reported from the automobile industries both here and in the US. The Board of Trade's announcement towards the end of last week that it intended to offer nearly 9,000 tons of zinc in the three months from the beginning of December was a prime factor in sending the market easier.

Mario Olivo Honoured

Mr. Mario Olivo was elected an honorary member of the *Verein Deutscher Giesserei Fachlente*, at the annual general meeting of that Association recently held in Düsseldorf. This honour was in recognition of his efforts, spread over many years, to intensify foundry co-operation internationally. His special interest was for many years the production of an international foundry dictionary.

When replying, Mr. Olivo presented a copy of "De Re Metallica"* by the scientific writer, Georgius Agricola, to the chairman. He pointed out that German/Italian co-operation in the field of metallurgy and foundry technique could be traced back to the 16th century. Agricola who lived in Venice, 1523-1526, moved first to Padua and then to Bologna, where he studied and obtained his Doctor degree. During these years he made the acquaintance of the famous metallurgist and mineralogist of the Renaissance period, Biringuccio Vannoccio. A valuable practical and scientific exchange took place which was of great advantage to Agricola when he wrote his important work "De Re Metallica," in 1556.

* The English translation of this book, made by H. C. & L. H. Hoover (1912), exists in the library of the Institute of Metals.

Latest Foundry Statistics

Ironfounding. The Council of Ironfoundry Associations states that on August 31 there were 138,136 workpeople engaged in ironfounding, which is an increase of 408 over the figures given for August 3, but 4,484 fewer than a year ago. During the month of August there was a decrease of 28 women workers.

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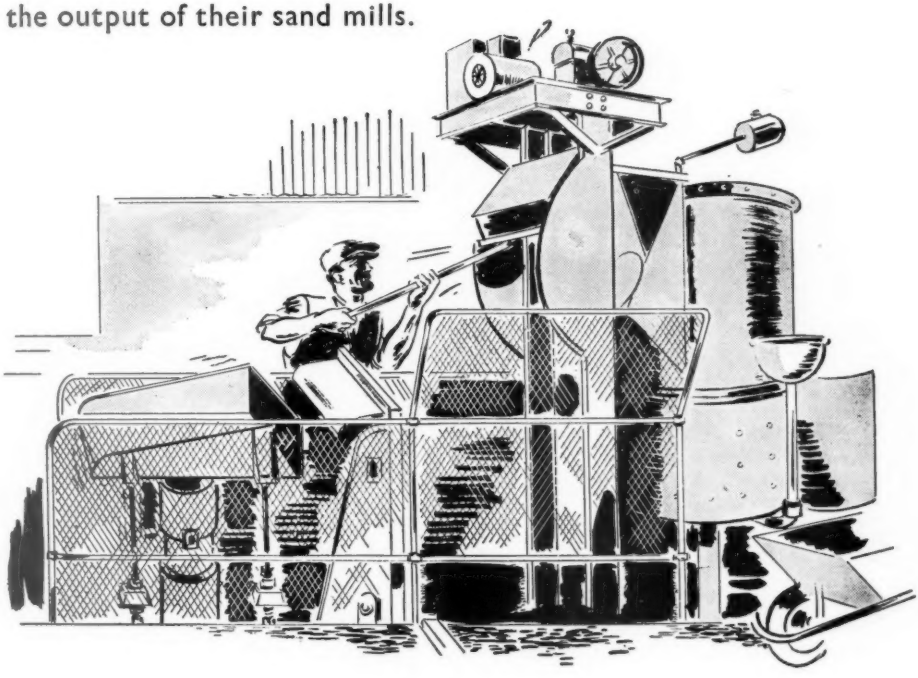

For service and information write to:

THE FULLERS' EARTH UNION LTD.

Patteson Court, Nutfield Road, Redhill, Surrey

Telephone: REDHILL 3521

CMF 13

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

November 6, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £52 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 2d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10½d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g. £45 16s. 0d.; black sheets (hand mill), 24 g., 59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 0s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £193 0s. 0d. to £193 10s. 0d.; three months, £196 10s. 0d. to £197 0s. 0d.; settlement, £193 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 10½d. per lb.; rods, 216s. 9d. per cwt. basis; 20 s.w.g., 250s. 0d. per cwt.

Tin.—Cash, £730 0s. 0d. to £730 10s. 0d.; three months, £715 0s. 0d. to £715 10s. 0d.; settlement, £730 10s. 0d.

Lead (Refined Pig).—First half November, £85 15s. 0d. to £86 0s. 0d.; first half February, £85 5s. 0d. to £85 15s. 0d.

Zinc.—First half November, £68 5s. 0d. to £68 10s. 0d.; first half February, £67 15s. 0d. to £68 0s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations £101 15s. 0d.; rolled zinc (boiler plates), all English destinations, £99 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 6½d. per lb.; sheets to 10 w.g., 165s. 3d. per cwt.; wire, 2s. 4d.; rolled metal, 165s. 3d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £139; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £183; HTB2 (38 tons), — ; HTB3 (48 tons), £209.

Gunmetal.—BS1400, LG2 (85/5/5/5), £170; LG3 (86/7/5/2), £180; G1 (88/10/2/½), £239; (88/10/2/1), £225

Phosphor Bronze.—BS1400, PB1 (AID released), £251 per ton

Phosphor Bronze Strip, etc.—Strip, 240s. 9d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s 7½d. per lb.; rods, 2s. 10½d.; tubes, 2s. 11d.; chill cast bars: solids 2s. 10½d., cored 2s. 11½d (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 6d per lb.; round wire, 10g. in coils (10 per cent.), 3s. 10¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 9¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £72 10s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £217; AB2, £236.

* Average 68-70 per cent.